NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS

1512 H Street, N.W. Washington 25, D.C.

SEPTEMBER 20, 1955

FOR p.m. RELEASE

PLUM BROOK, OHIO, ORDNANCE SITE CHOSEN BY NACA FOR RESEARCH REACTOR

The site for the 4-1/2 million-dollar nuclear reactor which the National Advisory Committee for Aeronautics, the government's aeronautical research establishment, will use in the study of problems related to aircraft nuclear propulsion systems will be on the northern part of the Plum Brook Ordnance Works near Sandusky, Ohio, it was announced today by Dr. E. R. Sharp, Director of the NACA's Lewis Flight Propulsion Laboratory.

Choice of the site was made after a thorough survey of 19 possible locations. The 7,000 acre Plum Brook Ordnance Works were used during World War II in the manufacture of high explosives and agreement for use of approximately 500 acres of this government-owned property was given by the Department of the Army.

Under the Atomic Energy Act the Atomic Energy Commission will consider the safety aspects of the facility. Dr. Sharp said that close coordination was being maintained with AEC on these matters.

In surveying the possible sites which led to the selection of the Plum Brook location as the best site for the nuclear facility, the NACA employed the Nuclear Development Associates of New York, an independent engineering firm specializing on problems associated with use of nuclear energy. It was desired to locate the new facility as near as practicable to the Lewis Flight Propulsion Laboratory at Cleveland because many of the scientists and engineers there will be making frequent visits to the work on propulsion systems problems which are being studied at the reactor site. In addition, substantial savings to the government will be possible by use of experimental shops and engineering services supplied by Lewis Laboratory personnel.

It is expected that the detail design of the new reactor now in progress will have been largely completed by the end of the year and that construction contracts will follow. No estimate of the completion date can be given. A staff of about 50 engineers plus other personnel will be located at the Plum Brook site.

Elaborate safeguards will be designed into the reactor to insure against possible danger to personnel working at the facility and to residents of the area. These safeguards include necessary precautions against nuclear contamination, both of drainage water and air currents passing over the facility. "A basic element of the new design will be the fail-safe features incorporated into the structure," Dr. Sharp explained.

"The performance capabilities to be realized from harnessing nuclear energy for aircraft propulsion would be nonstop flight to any point on the face of the earth and return," Dr. Sharp said. "With so large a gain the goal, industry, the Atomic Energy Commission, the Military Services, and the NACA are participating in vigorous, sustained attacks on the formidable technical problems that must be solved. The new reactor will be most useful in the solution of the complex problems on which the NACA is working."

NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS
Lewis Flight Propulsion Laboratory
21000 Brookpark Road, Cleveland 11, Ohio
WInton 1-6620

FACT SHEET (9-56):

WHAT LEWIS LABORATORY IS

Lewis Flight Propulsion Laboratory is one of three major research establishments operated by the National Advisory Committee for Aeronautics. Created by Congress in 1915, the NACA is the top aeronautical research organization of the Federal Government. NACA's 17 members are appointed by the President of the United States. Dr. Jerome C. Hunsaker of the Massachusetts Institute of Technology is Committee Chairman.

The business of the NACA is research -- scientific laboratory research in aeronautics. All of it is directed toward practical solution of the problems of flight. In this manner the frontiers of aeronautics are being advanced constantly. While NACA does not design or build airplanes, scientific knowledge gained by NACA is used by the military services and the aircraft industry in the design and development of improved aircraft and propulsion systems.

To obtain this knowledge, NACA operates the Lewis Flight Propulsion Laboratory which was established on a 200-acre site adjacent to the Cleveland Hopkins Airport in 1942; the Langley Aeronautical Laboratory started in 1918 near Hampton, Virginia; and the Ames Aeronautical Laboratory began in 1940 near San Francisco, California. The NACA also has smaller facilities at Wallops Island, Virginia, where rocket-propelled models are studied; at Edwards, California, where transonic and supersonic flight research is conducted with special research airplanes; and, now under construction near Sandusky, Ohio, the Plum Brook Research Reactor Facility, where problems of nuclear aircraft propulsion will be studied.

WHAT LEWIS LABORATORY DOES

The scientists, engineers and technicians of Lewis Laboratory are primarily engaged in the investigation of problems of aircraft powerplants and their components, including the special supersonic aerodynamic problems relating to high speed propulsion. (Research on wings, bodies, controls, and other components which will provide the safest and most efficient airplanes to fly at or beyond the speed of sound is conducted at the Ames Laboratory. Work at the Langley Laboratory covers aerodynamics, hydrodynamics, structures, stresses and allied fields.) Some of the many problems investigated at Lewis Laboratory are combustion, fuels, propulsion system structures, high-temperature materials, and lubrication. All types of modern and future aircraft propulsion systems and their components are studied, including turbojets, ramjets, rockets, and others.

THE PEOPLE OF LEWIS LABORATORY

Under NACA's Director, Dr. Hugh L. Dryden, and its Executive Secretary, Dr. John F. Victory, with headquarters in Washington, D. C., activity of the 2700-man professional and technical staff of Lewis Laboratory is directed by Dr. Edward R. Sharp, Director, and Mr. Abe Silverstein, Associate Director.

Varied professions and skills are required for aeronautical research. Lewis Laboratory's staff includes research scientists, aeronautical, mechanical, metallurgical, electrical, electronics, chemical, and ceramic engineers, physicists, test pilots, machinists, photographers, wood workers, mechanics, draftsmen, artists, instrument makers, metal workers, tool makers, electricians, clerical workers, and others.

TOOLS OF RESEARCH AT LEWIS LABORATORY

The Laboratory conducts continuous research utilizing over $100 million worth of the research tools. Problems of propulsion can be studied through the full range from chemistry of fuels to the operation of full-size engines under simulated conditions of high altitude flight.

Major research facilities at Lewis Laboratory include:

The Lewis Unitary Plan Supersonic Wind Tunnel, sometimes called the "10 by 10" because wind tunnels are measured by the size of the section in which the engine, plane or model is tested, is the newest wind tunnel at the Laboratory. Full-sized engines and components up to five feet in diameter can be studied in its 10 ft. by 10 ft. stainless-steel test section. Seven electric motors producing 250,000 hp and two multistage compressors will produce test conditions of speeds from 1500 to 2500 mph and altitudes up to 150,000 feet. A closed circuit television system permits remote monitoring of tests within the tunnel.

The Eight by Six Foot Supersonic Wind Tunnel is used to conduct tests on engines or their components at air speeds up to about 1500 mph in its stainless steel 8-foot by 6-foot test section. Three 29,000 hp electric motors drive the tunnel's axial flow compressor. The test object can be observed and photographed during operation.

The Altitude Wind Tunnel is used to test full-scale aircraft engines under conditions which simulate pressures and temperatures of altitudes up to 50,000 feet. This tunnel has a 20-foot diameter test section. Air is driven through it at speeds up to 500 mph by an 18,000 hp electric motor. Refrigeration equipment requiring 22,000 hp cools the air in the tunnel to -48° F.

NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS
Lewis Flight Propulsion Laboratory
Cleveland, Ohio

FOR RELEASE P.M. PAPERS
September 26, 1956

CONSTRUCTION BEGUN ON NACA RESEARCH REACTOR FACILITY

Ground was broken today for construction of the Plum Brook Research Reactor Facility of the National Advisory Committee for Aeronautics, near Sandusky, Ohio. The new facility will be used by the NACA, the Government's aeronautical research organization, in the study of problems of aircraft nuclear propulsion systems.

Dr. Edward R. Sharp, Director of the NACA Lewis Laboratory, headed a list of Government and local officials and civilian guests at the ceremonies. Among the speakers were Dr. John F. Victory, Executive Secretary, and Addison M. Rothrock, Assistant Director for Research, both of the NACA Headquarters in Washington, D. C. The reactor unit will be staffed and operated by the Lewis Laboratory, of which it is a part.

Harnessing of nuclear energy, Dr. Sharp pointed out, is vital if the United States is to maintain its qualitative lead in aeronautics. Before full development of the atomic powered airplane can take place, extensive research effort is necessary.

Dr. Sharp explained that NACA's primary interest in atomic power is conversion of the energy generated in a reactor to useful thrust, in the most efficient manner possible. "To do this," he said, "it is necessary to simulate in a safe and controlled manner the temperatures, stresses and

--more--

corrosion and radiation conditions which would be experienced in an atomic nuclear powerplant."

He added that the airplane powered by the atom will be capable of flying nonstop to any point on earth without refueling, and its flight endurance will be limited only by the endurance of the crew.

The reactor site, on a 500-acre portion of the Army's 7000-acre Plum Brook Ordnance Works, was selected last year following a thorough survey of 18 possible locations. The new reactor was located close to the Lewis Laboratory to enable scientists and engineers there to supplement the Plum Brook staff in study of propulsion problems. This location permits economical use of the management, experimental shops, and engineering services of the Lewis Laboratory.

The NACA is consulting closely with the Atomic Energy Commission in the design of the reactor facility, which will contain elaborate safeguards against all possible hazards to personnel working there or to residents of the area. Safety features include precautions against nuclear contamination of drainage water and air currents over the facility.

The reactor will be completed within three years and will be staffed by about 50 aeronautical scientists and 100 other employees. Construction is under the direction of James R. Braig and M. V. Organ. Both are associated with the NACA's Lewis Laboratory.

Contracts have been let to the Kilroy Structural Steel Company of Cleveland to supply the structural steel for the reactor building, and to the Hammond Iron Works of Warren, Pennsylvania, to build the containment tank.

-- more --

Other contracts will be let soon. Total cost of the facility will exceed $5,000,000.

Abe Silverstein, Associate Director of the Lewis Laboratory, said of the reactor, "Despite recent important increases in aerodynamic efficiencies for aircraft at supersonic speeds, nuclear power still is the 'shining hope' for increasing the range of aircraft at high speeds and for increasing aircraft ranges to values unobtainable with conventional or special chemical fuels."

"A long range bomber," Mr. Silverstein added, "may carry 100,000 pounds or more of fuel. A piece of Uranium 235 with the same energy content would weigh less than one ounce."

-END-

LEWIS

298 116.1-42

August 8, 1957

Mr. Matthew Portz
Aeronautical Information Specialist
Lewis Flight Propulsion Laboratory
21000 Brookpark Road
Cleveland 11, Ohio

Dear Matt:

Here is a draft of a release planned for use at the time the AEC announces its proposal to issue a permit to NACA to construct a nuclear testing reactor at the Plum Brook Ordnance works.

Except for paragraph #3, which includes information released by us at the time of the ground-breaking ceremonies in September of last year, the release follows very closely that prepared in draft form by the AEC.

It is my understanding that several days, perhaps even a couple of weeks, may go by before the AEC Commission takes the final action which will break the thing loose.

It is my further understanding that AEC will be able to give us about 24 hours' notice prior to filing of the notice of proposed issuance with the printers of the Federal Register. This, I am told, is tantamount to its being made public because, even though the notice may not then appear in the Register itself for a day or so, such filings are available for inspection by reporters.

We plan to make the material available to the local reps of the Cleveland papers -- on the basis that this is not red hot news but that we wish to keep them informed. Perhaps you would want also to make it available to the Cleveland aviation editors. I would believe and expect the Sandusky paper and radio station also would be interested, and would hope you could service them.

Every good wish,

Walt

Walter T. Bonney
Assistant to the Executive Secretary

WTB:ejv

DIRECTOR
ASSOC DI
Budget
PBRRF
Lib
P-C
M&S
Physics
P-A
P-S
F-S
N-R
Res Rpt
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Draft
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CCA
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For release concurrently
with AEC announcement

HOLD FOR RELEASE

AEC proposes to issue permit
for construction of NACA testing reactor

The Atomic Energy Commission has filed notice of proposed issuance of a permit to the National Advisory Committee for Aeronautics for construction of a large testing reactor at the Plum Brook Ordnance Works near Sandusky, Ohio.

The NACA reactor is especially designed for use in studying problems of aircraft nuclear propulsion systems. It is a modification of the AEC's Materials Testing Reactor (MTR) at the National Reactor Testing Station in Idaho. It will be composed of a graphite-uranium core contained in a reactor pressure tank shielded by concrete and water in a circular pool, and further contained in a cylindrical steel tank. It will operate at a thermal power level of 60,000 kilowatts.

Site excavation for the NACA's Plum Brook Research Reactor Facility was begun last fall. Since then, contracts have been let for construction of the reactor building and of the steel tank which will contain the reactor. The facility, for which $5,080,000 has been allocated, is scheduled for operation in 1959.

The reactor unit will be staffed and operated by the NACA's Lewis Flight Propulsion Laboratory located at the Cleveland airport. Some 50 aeronautical research scientists and a hundred other employees will be assigned to the Plum Brook Facility. The reactor will be used in various research investigations to further development of reactors suitable for aircraft propulsion, including loop studies of fuel elements and other components, radiation effects studies, shielding studies, and nuclear and solid state physics experiments.

NACA has applied for a license extending through 1970. Simultaneously with issuance of the construction permit, the AEC will allocate 224 kilograms (493.83 pounds) of contained U-235 for use as reactor fuel over the license period. This is a net figure -- transfers of U-235 from the AEC to the NACA, less returns to the Commission of U-235 in recoverable fabrication scrap and spent fuel elements.

The Commission has concluded that a reactor of the type proposed can be constructed and operated by NACA at the proposed site without undue risk to public health and safety.

Notice of proposed issuance of the construction permit will be published in the Federal Register on _____, 1957. The permit will be issued unless within 15 days after that date a request for a hearing is filed with the Commission.

-- 30 --

WTB:ejv

August 8, 1957

Box 298 116.1-42

NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS
LEWIS FLIGHT PROPULSION LABORATORY
CLEVELAND 11, OHIO

FOR RELEASE: 4 p.m. September 5, 1957

AEC SCHEDULES HEARINGS IN NACA LICENSE APPLICATION

The Atomic Energy Commission has scheduled a public hearing October 8 in the matter of the proposed issuance to the National Advisory Committee for Aeronautics of a permit to construct a large testing reactor at the Plum Brook Ordnance Works near Sandusky, Ohio.

This action has been taken in accordance with an amendment, signed by the President on September 3, to the Atomic Energy Act of 1954 which requires that public hearings be held on license applications for power and testing reactors.

The hearing will be held at 10 a.m. October 8, in Conference Room F, in the Interstate Commerce Commission Building in Washington, D. C. In addition, the AEC will refer the NACA application to an Advisory Committee on Reactor Safeguards which is to be established in accordance with the recent amendment to the Atomic Energy Act.

The NACA reactor is especially designed for use in studying problems of aircraft nuclear propulsion systems. It is a modification of the AEC's Materials Testing Reactor (MTR) at The National Reactor Testing Station in Idaho. It will be composed of a core contained in a reactor pressure tank shielded by concrete and water in a circular pool, and further contained in a cylindrical steel tank. The reactor will be designed to operate at a maximum thermal power level of 60,000 kilowatts.

Site excavation for the NACA's Plum Brook Research Reactor Facility was begun last fall. Since then, contracts have been let for construction of the Reactor Building and of the steel tank which will contain the reactor. The facility, for which $10,735,000. has been appropriated, is scheduled for completion in 1959.

NACA has applied for a license extending through 1970. It intends to use the reactor in various investigations to further development of reactors suitable for aircraft propulsion, including loop studies of fuel elements and other components, radiation effects studies, shielding studies, and nuclear and solid state physics experiments.

-END-

NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS

1512 H Street, N.W. Washington 25, D.C.

FOR IMMEDIATE RELEASE
December 11, 1957

Dr. Hugh L. Dryden, Director of the National Advisory Committee for Aeronautics, upon being informed by the Atomic Energy Commission of the reports by the newly formed Advisory Committee on Reactor Safeguards and the AEC staff concerning the NACA's Plum Brook Reactor Facility near Sandusky, Ohio, today made the following statement:

"The NACA's Plum Brook Reactor Facility has been designed with safety always the paramount requirement.

"Throughout the two and a half years since Congressional approval and financing, the design of the facility, together with necessary site preparation and initial construction of the foundations and supporting structure, all have been coordinated to the fullest extent with the AEC staff. As design has proceeded, the AEC staff and its Hazards Committee (since replaced by the Advisory Committee on Reactor Safeguards) have made suggestions based upon their broad and long experience in reactor design and operation. In every case, these suggestions have resulted in mutually satisfactory changes leading to even further 'built-in safety'.

"Throughout its 42 years as the nation's aeronautical research agency, the NACA has always stressed the supreme importance of safety, not only for its employees but even more, for the communities in which its research centers are located. Over this period, the NACA has pioneered in the design and construction of large research facilities, many of which have been revolutionary in character. Despite this, the safety record of the NACA has been unequalled.

"The Lewis Flight Propulsion Laboratory of the NACA, which will staff and operate the Plum Brook reactor from its Cleveland facility, has won the National Safety Council's highest safety award for three years.

"The NACA will, of course, continue to consult with the Atomic Energy Commission, thus to insure the safety of every aspect of the operation of the Plum Brook facility."

-- END --

FACT SHEET

NACA Plum Brook Reactor Facility

Authorized by Congress May 23, 1955 (P. L. 44, 84th Congress)

Total funds appropriated for project, $10,735,000.

Site chosen September 20, 1955, after survey of 19 available locations by Nuclear Development Associates (now Nuclear Development Corporation).

Ground broken and construction begun September 26, 1956.

Atomic Energy Commission orders hearing to issue license, September 4, 1957.

The NACA reactor is especially designed for use in studying problems of nuclear propulsion systems for aircraft and missiles. It is a modification of the AEC's Materials Testing Reactor (MTR) at the National Reactor Testing Station in Idaho. It will be composed of a graphite-uranium core contained in a reactor pressure tank shielded by concrete and water in a circular pool, and further contained in a cylindrical steel tank. It will operate at a maximum thermal power level of 60,000 kilowatts.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
LEWIS RESEARCH CENTER
CLEVELAND, OHIO

LEWIS SCIENTISTS DEVELOP
PROTOTYPE ION ENGINE

For P.M. Papers
October 12, 1959

Langley Research Center, Va., October 12-- The prototype of an electrical space engine, using ion beams, has been developed at the National Aeronautics and Space Administration's Lewis Research Center, Cleveland, Ohio.

Lewis scientists reported working models of the ion system have been constructed and plans for building larger units are underway.

A small-scale ion engine was unveiled here today at NASA's annual inspection. This week the agency's research organizations are recounting progress made during 1959.

Research at Lewis over a number of years has established that low-thrust, electrical propulsion systems may be the answer for the movement of space vehicles, either for earth orbital assignments or actual interplanetary travel. Other space propulsion systems under study at Lewis include nuclear and chemical rocket engines.

Use of low-thrust propulsion may be highly practical in outer space since, in that environment, neither friction nor weight requires support. Electrical systems can provide small thrusts-- accelerations of .001 gravity or much less than that experienced in the normal "get-away" of a standard passenger car-- but they are not limited in terms of jet velocity.

According to Lewis scientists, jet velocity values of 216,000 mph seem feasible for driving an electrically-propelled ship on a space journey.

Development of an ion begins with an atom of cesium, a metallic element of interest to electrical propulsion. When one of its electrons is removed, the atom changes from a neutron to a proton and becomes an ion. When a large number of ions and electrons are mixed, the resulting substance becomes a "plasma," or ionized gas. Acceleration is accomplished through use of its electrical conductivity when a current is passed through the plasma in the presence of a magnetic

field. Thus, actual propulsion is achieved. Energy is provided by a nuclear drive turbo electric system.

Lewis scientists in describing a possible earth-to-Mars journey of a low-thrust electrically-propelled space ship, said that upon assembly in orbit, the craft's first movement will be hardly discernable. Initial acceleration will serve to slightly and slowly increase the height of the orbit. However, as the distance from earth increases, the change will be more noticeable. Each revolution about the earth will augment the size of the orbit until the space ship will have boosted itself to a velocity that will move it from the earth's gravitational field and go into solar orbit.

Acceleration will continue until the solar orbit has become an ellipse which is tangent both to the orbit of earth and that of Mars. At this point the power will be cut off and the ship will coast until it arrives in the vicinity of Mars. Here, acceleration will be used in reverse; the vehicle's thrust being used to reduce orbital speed and ease it into a satellite orbit around the planet.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

IN REPLY REFER TO

LEWIS RESEARCH CENTER
21000 BROOKPARK ROAD
CLEVELAND 35, OHIO
TELEPHONE: WINTON 1-9620 TWX: CV 920

Friday, March 4, 1960

PRESS MEETING

MULTIPLE AXIS, ROTATIONAL TEST FACILITY

The press meeting began at 9:20 a. m. with Mr. Harry McDevitt, Lewis Information Director, providing the introduction.

* * *

Press meeting participants were:

Bruce T. Lundin, Assistant Director, Lewis
R. R. Miller, Rocket Systems Branch, Lewis
John A. Powers, Space Task Group Information Officer
The following astronauts:

Malcolm S. Carpenter
Donald K. Slayton
Walter M. Schirra, Jr.

* * *

MR. McDEVITT: Good morning and congratulations to you all for mushing through a record snow storm to join us here this morning. We are well aware that some of you sat up all night on trains and drove great distances, since our airport has been virtually closed for 24 hours.

Today, with the assistance of John Powers of the Space Task Group, and three of the astronauts (three others will join us after the snow-bound train from Washington arrives), we hope to explain, in some detail, the Lewis Research Center's contributions to the Project Mercury program. Later, the astronauts will be introduced and you will have an opportunity for both questions and photography. Please hold all questions until our brief oral presentations are concluded.

Let me say that the next time we call a press meeting at Lewis, we will surely consult the almanac. It seems that this year's edition predicts just a little snow for today.

Bruce Lundin, Assistant Director of Lewis, will now provide a brief background of this Laboratory and describe the continuing phases of our work in the project Mercury area.

MR. LUNDIN: Thank you.

Our main business here today is, of course, to tell you about the astronaut training and test program that is being conducted here and to give you an opportunity to meet some of the people directly involved. I am mindful here, however, of a discussion I had recently in New York with some of the leading members of your profession regarding the job of the press in our society. As we discussed the great need, and some of the problems, of providing the American public with a proper appreciation and understanding of what we are doing in this space business, it was emphasized to me that this requires not only accurate and responsible reporting on your part, but also that it is the responsibility of we, in the technical end of the business, to give you the facts as completely, as accurately, and as many of them as possible.

Mindful, as I say, of this obvious truth, I want to summarize for you very briefly our total program here at Lewis relating to the Mercury program; others here today will deal in more detail with the astronaut test and training part of our work. To give you a little more perspective, I might also mention that our efforts on the Mercury program involve only some one per cent or so of our total research effort at this Center. Needless to say, however, a very high priority one or two per cent.

The central technical management of the Mercury program, and most of the design and engineering work is, as you may know, centered at our Langley Center in Virginia. Our activities here at Lewis relate to selected areas in which we have particular competence and research facilities. To properly relate these selected pieces of work to the total program, a brief sketch of Mercury -- what it is and how it works -- may be in order.

Project Mercury is, of course, America's effort to place a man in orbit about the Earth at the earliest practicable date. It has been viewed by some as the next logical, progressive extension of man's capability in flight that has been growing now for over fifty years; an advance in altitude of over five-fold and a growth in speed of nearly ten-fold. To me, however, Mercury is far more of a pioneering effort; man's first, small step of finally escaping the bounds of his earthly home. A preliminary, first step that must be taken if we are ever to achieve physical contact with our moon and the nearby planets.

To take this small, but most significant first step into space at an early date, a modified Atlas ICBM is used as the launching vehicle. This rocket booster will accelerate the Mercury capsule with its single human occupant inside of it, to orbital speed -- about 18,000 miles per hour, and inject it into an orbit about 100 miles above the surface of the Earth. The early flights will be of rather brief duration, a four or five hour ride of three orbits about the Earth.

To maintain human life within this capsule, means are, of course, provided to maintain the cabin environment at proper levels of temperature, pressure, humidity and composition. To protect the pilot from high acceleration loads of launch and re-entry through the Earth's atmosphere, he is provided with a form-fitting couch, an example of which you will see a little later today. Protection from the intense heat of re-entry is a most essential requirement that is satisfied by an ablative heat shield, a rather thick cover over the forward, or blunt, end of the capsule which, in partially melting away, absorbs the heat generated by air friction. To come down from orbit requires the application of a reverse, or braking thrust to reduce the capsule's speed. This is accomplished by firing small retro rockets installed in the capsule's front end. Return to the Earth's surface and recovery will be effected in the Atlantic Ocean, downrange from Cape Canaveral.

Of somewhat more specific concern to us here today is the need for controlling rather precisely the position, or orientation, of the capsule during its flight through space. Shortly after its separation from the Atlas booster, the capsule must be rotated end to end so that the pilot, on his couch, is facing properly to take the re-entry deceleration and the heat shield, which was on the bottom of the capsule when in the launch position on the Atlas, is now facing forward. While in orbit, the capsule must be controlled to prevent tumbling about and the flight direction and orientation of the capsule must be properly lined up before re-entry into the atmosphere to prevent excessive heating or too high a deceleration load.

The principal flight events are, then, launch, separation from the Atlas booster, rotation and orientation in space, nearly continuous communication, and data receiving by a global system of tracking stations, line-up and retro rocket firing for return from orbit, a parachute landing in the Atlantic and recovery by one of several ships deployed in the landing area. I should also mention the escape system. This is an

arrangement of special rocket engines which, if any malfunction occurs during launch and booster operation, will pull the capsule off of the Atlas so that it can land safely by itself.

The rotation and orientation of the capsule in space, where there is, in effect, no up or down and no air for wings or actual surfaces to bite on, is accomplished by several small jets of hydrogen peroxide on the capsule's surface. Some for roll, some for pitch, and others for yaw control. Now, control of these jets will be possible in a completely automatic manner by a gyro-referenced control system. This automatic control system is necessary not only to relieve the pilot of this chore, but also to permit early, unmanned flights and flights with animal passengers.

Should the pilot so desire, however, or as a manual backup, he is also provided with the necessary instruments, control stick and other control equipment to do much of the job of flying the capsule himself. He, therefore, becomes a part of the control system and his ability to read instruments, perform mental interpretations and decisions, and operate the controls in harmony with the rest of the control system while spinning about in many possible directions become of real research interest. To investigate the abilities and limitations of the man and the man-machine combination in this new and unique set of circumstances, a series of tests are in progress here in what we call a gimbal rig. In this facility, the pilot and his simulated capsule is rotated about all three axes, either separately or in combination and, when spinning about at various speeds, is required to perform various corrections or piloting maneuvers. But further details of this program will be covered by others here today.

I should tell you, however, that this gimbal facility was not actually built specifically for this job and that this area of research into human response and control capabilities is quite new to us. This is, in fact, one more example of serendepity in research facilities. Actually, the facility was constructed about a year ago to test and develop the automatic control system for the Big Joe shot last fall. The Big Joe shot, as you may recall, was a 1500 mile ballistic flight that had as its primary objective a test of the proposed ablative heat shield and other parts of the landing and recovery equipment. To properly test the heat

shield required, as I mentioned, that the flight path and position of the capsule be rather accurately controlled. To this end the staff of this center designed, tested and developed the complete control system, the instrumentation and telemetry equipment and, in fact, the flight capsule itself was built in our shop. Although, as you may recall, a failure of the booster engines to separate properly from the Atlas prevented a perfect flight. The re-entry heat shield, recovery, and all other parts of the capsule equipment operated perfectly.

A third phase of our program here related to the separation system, the small rocket engines, explosive bolt, clamping rings, etc. that are provided to make sure the capsule separates clearly and properly from the Atlas booster. As you may imagine, a failure of any of this equipment would be most undesirable. Tests of this equipment in one of our large wind tunnels with the top end of an Atlas and a full- size capsule have now been completed, as is frequently the situation, various design faults were discovered in these tests and the information required for corrective action was obtained.

Immediately following the present program of pilot testing and training, we will be investigating certain aspects of the escape system. Because of the location and direction of firing of the escape rocket, the exhaust fumes will impinge upon the top of the capsule and the pilot observation window. The problems of capsule heating and erosion of the window will be primary objectives in these tests.

As you may well imagine, proper functioning of the retro-rocket system, which reduces the capsule's speed so that it can come out of orbit and back to earth is of real importance. A fifth aspect of our program will therefore test out this system. In particular, we want to make sure that the misalignment of the line of thrust of the rocket with the center of gravity of the capsule will not be so great as to exceed the capabilities of the control system and tumble the capsule just before re-entry.

The last phase of our presently planned program is devoted to the little hydrogen-peroxide control motors themselves. Investigating their starting and stopping capabilities, their efficiency of utilizing the propellant on board and their general endurance. Without proper performance here, of course, all control is lost.

Well, I didn't really intend to talk this long, and perhaps I shouldn't have. I did, however, feel that some outline of the Mercury program and our various programs here at Lewis may help you in understanding the more detailed aspects you may be exposed to either here today or elsewhere in the future. I certainly thank you for your attention.

MR. ROBERT R. MILLER:

The Lewis Research Center is currently working on five projects concerning Project Mercury:

a. Separation tests
b. Abort rocket firings, blast and noise effects on the capsule
c. Retro rocket firings, thrust allignment tolerances
d. Hydrogen peroxide, starting characteristics and performance evaluation, and
e. Pilot disorientation tests and astronaut training.

I am concerned only with the multiple axis facility. There are three concentric cages with complete rotational freedom about three axes which simulates pitch, roll and yaw.

The inner cage contains a life support couch, the pilot is seated in the couch and can control the rotation system with a side-arm controller, the same as in the Project Mercury capsule. The controls operate nitrogen jets causing the cages to rotate.

The test engineers turn each cage independently up to the test speed desired, at this time control of the Gimbal is transferred to the pilot. By action of the side-arm controller the pilot reduces speed on all three axes to zero. We then record the research information.

There is an old saying that a picture is worth a thousand words. (MASTIF Film dated November 3, 1959)

The major objective is to determine the pilot's reaction during tumbling and his efficiency in recovering from tumbling. While spinning on one axis, the reaction time is zero, and the efficiency good. Multiple axis runs have shown a definite reaction time and the pilot's efficiency during the runs drops appreciably.

Runs have been made at speeds up to 50 rpm on one axis and at speeds up to 30 rpm about three axes.

Tumbling of a pilot at speeds of about 20 rpm induces an interesting condition, ocular nystagmus, which is a blurring of the pilot's vision. Sharp vision returns almost immediately when accelerations are

eliminated and rotation at a constant rate is experienced. Although blurring of the pilot's vision would hamper the proper control of a space vehicle, our investigation at Lewis goes well beyond the rates contemplated in the Mercury Project. The test conducted on the NASA astronauts in the Multiple Axis Facility showed the astronauts would have no problem controlling the Mercury Capsule in space. Some recent runs have evidenced that the nystagmus condition may possibly be controlled by the pilot, in other words with practice the pilot may be able to overcome the eye blurrings.

Since the facility was put into operation, it has been in constant useage and we feel it is quite unique. The scope of its usefulness is very broad, both in the field of controls research and aeromedical investigations. Much interest in the use of the facility for future research has been expressed by the Life Sciences Division of the NASA and the medical people of the military services.

In closing, I would like to say that I have enjoyed working with the astronauts. They are an earnest, hard working, highly competent group and I feel our Project Mercury is in good hands.

I would like to introduce to you now, John A. Powers from the Space Task Group, Langley Field.

JOHN A POWERS: Thank you.

We last met with the press at Edwards Air Force Base in December where the astronauts were undergoing zero gravity training in an F-100-F. This training was done under the guidance of the School of Aviation Medicine.

They have been busy, but not in group type activities since this time. Each astronaut has been assigned a specialized area and during January we had seven men in seven different locations. The men also had time to catch-up with their military duties. The areas of the three here are:

Schirra - Life support system and pressure suits. He has made a number of trips to Akron regarding the Mercury full-pressure suit.

Slayton - He is the Atlas expert on the program.

Carpenter - Star gazing. He is studying navigation and communication aids.

In February at Lewis, six have completed training. Cooper has been absent due to illness in the family and has quite a bit of catching-up to do.

Previous to this they were at Moorehead Planetarium for training in astronomy. The orientation of the location of heavenly bodies with particular emphasis on those stars and constellations seen while in orbit. At the conclusion of this training they rode in a simulated capsule and were disoriented and required to navigate with the stars as their guide.

Introduction of astronauts, Malcolm S. Carpenter, Donald K. Slayton and Walter M. Schirra, Jr.

The astronauts are now available for questions from the floor.

QUESTION: If at 20 rpm you experience ocular nystagmus, how many rpm do you expect to be going at in the actual flight?

WALTER SCHIRRA: Control in the capsule is automatic; if the automatic controls fail, manual control, such as that in the gimbal rig will keep the rpm low.

QUESTION: What are the rpm you plan to encounter in space?

WALTER SCHIRRA: We expect to keep it under control, hopefully it would be zero, possible one or two rpm to be brought under control in less than thirty seconds. Minor adjustments would be made from then on. Any rotations would then be only to look at specific stars or constellations but, the rotation would be very slow.

QUESTION: Aside from specific training here, summarize specific progress on the program.

MALCOLM CARPENTER: Because this is the first program of this type, every effort has been made to overtrain. The rotation here, for example, is far and above anything we expect to encounter. If we can handle this, we know we can handle what we would encounter in space.

QUESTION: How far has the program progressed - has a target date been set for completion?

MALCOLM CARPENTER: The dates are only for the training program which will be up to flight time. More time will be spent on this and getting out of the capsule.

JOHN POWERS: Yes, certainly a date has been set. You have to notify contractors when to deliver hardware - you have to schedule launch facilities, etc.

QUESTION: Can you tell me if a date has been set?

JOHN POWERS: Yes, you can't have a program this big without a date, you have to notify the people involved.

QUESTION: What is the date?

JOHN POWERS: The specific date is classified. The only thing available is that it is in the year 1961.

We have been in business with the Space Task Group at Langley since October 1958 and since that time we have gotten organized. The purpose of the program is the investigation of man's capabilities in the space environment. We are simulating as many conditions as we know about and that he may expect to encounter. We have launched four research development capsules with the Little Joe booster, and one research development capsule on an Atlas booster. We have done tests on the different subsystems in the escape system and achieved satisfactory results.

QUESTION: From the standpoint of physical and mental stress, I have heard you thought the centrifuge was the worst. How does it compare with this?

DONALD SLAYTON: The centrifuge was the toughest. This is the most nauseating. It is difficult, but not a physical strain. Just nauseating.

QUESTION: If you fall down in any part, will you be eliminated? Is there much discussion among yourselves as to who will be the first man?

WALTER SCHIRRA: First, probably only by reason of physical disqualification. Second, there is probably about one-hundredth as much among ourselves as among the news media.

QUESTION: In the training here what was the highest rpm encountered?

WALTER SCHIRRA: Thirty rpm on all axes and 50 rpm on the roll axis.

QUESTION: In your experiences of nausea, were you or were you just about to be?

WALTER SCHIRRA: Just about to be.

QUESTION: Is there a noticeable slow down of reaction time?

WALTER SCHIRRA: Your mental ability is still with you, although your vision is blurred and this clears rapidly.

DONALD SLAYTON: If it comes on, you are aware of it and recognize it.

QUESTION: Does it increase?

DONALD SLAYTON: It continues as long as you are accelerating.

MALCOLM CARPENTER: We found in the centrifuge that, with a little practice, you can avoid ocular nystagmus or delay its effects. With proper training, the effects can be greatly reduced or, if you strain, you can see much longer than in ordinary conditions. You can learn how to fight it.

QUESTION: Step-by-step, what happens up to the point when you experience this?

JOSEPH ALGRANTI: Under the hood you have no outside references, there are three rate gyros. When starting, you are quite aware of what is going on and are greatly inclined to stop the motion. It is similar to an uncontrolled spin. After several hours of exposure you are used to it and it is not bothersome. It is just another type operation, like flying an airplane.

QUESTION: How does it feel physically? What happens step-by step?

JOSEPH ALGRANTI: Your internal organs move about and you do move about under acceleration. At the lower rates you can tell you are being spinned about. At a high rate, you feel high-speed jostling. In terms of something familar, it is like what a trampoline or gymnastic artist experiences every day, except you are restrained by a harness.

MALCOLM CARPENTER: Nausea comes from sloshing around. In space there will not be any nausea experienced as long as you are in orbit. The only sensation will be from the inner ear.

QUESTION: Where do you go from here?

JOHN POWERS: Back to Langley, there is nothing firm enough at this time to discuss.

QUESTION: How much time was spent by each of you in the Rig?

JOSEPH ALGRANTI: About four hours per man.

WALTER SCHIRRA: The rig has to be stopped periodically to recharge the nitrogen bottles. The rotating and maneuvering lasts less than a minute and a half but seems longer.

QUESTION: What safety devices are there, is there a parachute device?

JOHN POWERS. The emergency escape system which has three possible sources of action:

1. Automatically by the equipment built in the booster
2. By the launch control officer in the block house, and
3. By the astronaut, by what they fondly call the "chicken switch."

There is the chance of failure of the rocket and a means for the pilot to escape from the vicinity of the rocket motor during the initial phase of the flight has been provided.

A small rocket motor is mounted on the front end of the capsule. This will fire the escape rocket and will burn long enough to get the capsule away from the booster. After the escape rocket is fired, the tower is jettisoned and the capsule turns around. After the attitude changes, a parachute is used to stabilize it and recovery is made in a normal manner.

QUESTION: Do you have a pet name for the rig?

WALTER SCHIRRA: It was originally called MASTIF and I believe that is a good name for it.

JOHN POWERS: The best place to be after the capsule lands is inside it. If difficulties are encountered, or the capsule is damaged and does not float, he will naturally have to get out.

MALCOLM CARPENTER: Langley has a towing basin with a one-half mile long channel and a wave making machine at one end. We dropped the capsule, without separation rockets, into the water and practiced getting out. First in a flight suit and then in a regular space suit, in still and rough water. This is called a water-regress trainer. We are not strapped in the couch, they close the hatch and push you out into the water. You remove the right side of the instrument panel and get up on your hands and knees and release the pressure hatch behind the instrument panel. As this is done you can then stretch out and begin to stand up. The parachute canister has to be pushed out before you can get through the hole which is about one-half the size of this upper neck of the capsule (pointed to model). You have to push the parachute canister out with your helmet, or hands if you can get them up. You then take hold of the lanyard which leads to the life raft. By this time you can look around. You lower the raft overboard and it then inflates automatically. You then get from the capsule into the raft. It is difficult in rough water because of the pitching and rolling. The capsule tends to tip over and you have to get out fast or try to control the capsule by moving around the top. Another thing is the landing bag which extends about 4-inches below the capsule and fills with water, this is a stabilizing device. As the capsule tilts the water runs out of the bag and the capsule tilts over further, you have to get out quick. It is not desirable to let the capsule tip over because the capsule will be a total loss.

QUESTION: Are you satisfied with this system?

WALTER SCHIRRA: This is an emergency operation only, you have from one to two minutes before the capsule turns over. The environmental control system must support you in the capsule after impact. Getting out is merely the choice of the astronaut. The best place would be with the capsule. If you get out, you will sacrifice the capsule and lose it. You can also get out the side hatch (Pointed to model) but this would also sacrifice the capsule since it would fill with water and sink. The thing to remember is that we should not have to get out of the capsule.

QUESTION: What are the chances of landing on land?

WALTER SCHIRRA: A land landing is most probable in an off-the-pad abort. That is why we have the impact bag, it can withstand the shock.

GENERAL STATEMENT: Every conceiveable safety device has been included in the capsule and is backed-up. About three things would have to fail before the unexpected would occur --- we are training for this.

(The press conference was concluded at 11:00 am)

Been operated
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ATTACHMENT #1

Advisory Committee on Reactor Safeguards
United States Atomic Energy Commission
Washington 25, D. C.

March 14, 1960

test materials
under cold
Lig H temps

Honorable John A. McCone
Chairman
U. S. Atomic Energy Commission
Washington 25, D.C.

Subject: NASA [PLUM BROOK REACTOR] FACILITY

Dear Mr. McCone:

At its twenty-fourth meeting the Advisory Committee on Reactor Safeguards considered the design of this facility. This reactor was previously reviewed at its second meeting and advice given in a letter of November 5, 1957. The Committee had for reference the reports listed below and the benefit of comments from the Staff of AEC and others. An ACRS Subcommittee and members of the Hazards Evaluation Branch visited the site and observed and discussed the nearly completed facility. The proposed operation procedure was also briefly reviewed with the NASA Staff, who designed the reactor and will operate it.

This reactor is a 60 MW thermal test reactor similar to the MTR, designed to accommodate a large number of experiments including loop tests. It has a high degree of containment, and controlled holdup storage for gaseous and for liquid radioactive effluent. NASA proposes a gradual approach to its maximum power density which is higher than that in the MTR.

In its previous report, the Committee concurred in the necessity of controlled release of radioactive gas or liquid effluents as proposed by the NASA. This was deemed necessary due to the proximity of the City of Sandusky, Ohio. For the same reason, proposed experiments will have to be carefully reviewed and appropriate limitation may be necessary at this site.

(more)

The Committee considers that the design of the facility is satisfactory for the purposes intended. While not now commenting on the operating procedures or the design of experiments, the Committee believes that this reactor should be capable of being operated without undue hazard to the health and safety of the public.

Sincerely yours,

/s/ Leslie Silverman
Chairman

(more)

AEC

UNITED STATES
ATOMIC ENERGY COMMISSION
Washington 25, D. C.

No. C-68
Tel. HAzelwood 7-7831
Ext. 3446

FOR IMMEDIATE RELEASE
(Friday, April 15, 1960)

ADVISORY COMMITTEE REPORTS TO AEC ON SAFETY ASPECTS OF TWO REACTOR PROJECTS

The Advisory Committee on Reactor Safeguards has filed with the Atomic Energy Commission reports on safety aspects of two reactor projects. These are

1. The Plum Brook testing reactor of the National Aeronautics and Space Administration near Sandusky, Ohio.

2. The power reactor project of Philadelphia Electric Company, with reference to a site at Peach Bottom, York County, Pa.

The reports, copies of which are attached, have been placed in the Commission's Public Document Room at 1717 H Street, N.W., Washington, D.C.

The National Aeronautics and Space Administration is building its testing reactor at Plum Brook under a construction permit issued by the Commission. The Commission is considering an application from NASA for a license to operate the reactor.

Philadelphia Electric Company plans to construct a power reactor on its utility system at Peach Bottom under the Commission's Power Demonstration Reactor Program. The Company has not yet applied for a construction permit. The attached report of the Advisory Committee on Reactor Safeguards relates to suitability of the proposed site.

- 30 -

Attachments

41560

ATTACHMENT #2

Advisory Committee on Reactor Safeguards
United States Atomic Energy Commission
Washington 25, D.C.

March 14, 1960

Honorable John A. McCone
Chairman
U. S. Atomic Energy Commission
Washington 25, D.C.

Subject: PEACH BOTTOM ATOMIC POWER STATION - PHILADELPHIA ELECTRIC COMPANY

Dear Mr. McCone:

At its twenty-fourth meeting the Advisory Committee on Reactor Safeguards considered the proposal of the Philadelphia Electric Company to construct a 115 MW (thermal), helium cooled, graphite moderated, high temperature reactor at its Peach Bottom site, a location on the west shore of the Susquehanna River, nine miles upstream from the Conowingo Dam. In addition to the applicant's presentation and the Site Evaluation Report, the ACRS had the benefit of comments from the Staff of the AEC and others. A subcommittee meeting was held with the applicant, his contractors and consultants, and members of the AEC Staff, on February 17, 1960.

The location of this reactor on Conowingo Pond, which is a potential supply of potable water to the City of Baltimore, and serves several smaller cities, makes mandatory an especially careful consideration of factors which might lead to pond contamination. The applicant has presented preliminary evidence, in the form of the results of preliminary analyses, indicating that in fact pond contamination will not present an undue hazard.

The design of this reactor, although not yet fixed, will necessarily be such that routine reactor operation may be accompanied by considerable fission product contamination of the coolant gas stream. This places particular emphasis on the need for reliability of the helium coolant system, the associated fission product traps, and the outer containment shell.

(more)

The Advisory Committee on Reactor Safeguards believes that the Peach Bottom site provides a generally acceptable degree of isolation when considered in relation to the proposed high integrity containment, and concludes the site is suitable for a reactor of the general design and power level proposed.

Sincerely yours,

/s/ Leslie Silverman
Chairman

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AL-61-48

UNITED STATES
ATOMIC ENERGY COMMISSION
Albuquerque Operations Office
P. O. Box 5400
Albuquerque, New Mexico

November 1, 1960

Office of Information
ALpine 6-4411, Ext. 5-1239

Holmes

FOR IMMEDIATE RELEASE

(NOTE: The following is being issued in Washington by the National Aeronautics and Space Administration and the Atomic Energy Commission).

The National Aeronautics and Space Administration and the Atomic Energy Commission announced today that a request for proposals will be sent to a number of manufacturers for research and development of a nuclear rocket engine. The nuclear rocket propulsion program (Project Rover) is a joint responsibility of the AEC and NASA, and managed by the joint AEC-NASA Nuclear Propulsion Office, established on August 31, 1960.

Project Rover-completed experiments to date include three nuclear reactors. The last experiment, Kiwi-A3, was successfully ground tested by its designer, the Los Alamos Scientific Laboratory, at the Nevada Test Site on October 19. This reactor used high pressure hydrogen gas for its propellant.

The decision to select a qualified contractor to provide engineering support and to conduct research and development of the nuclear rocket engine cancels a NASA request of August 19, 1960, to qualified contractors for proposals on a six-month's preliminary design study.

The joint office made a careful evaluation of program requirements, which indicated that the interests of Project Rover would best be served by an early selection of an industrial contractor.

The invitation for proposals will be sent to all those qualified and adequate time will be allowed for proposal preparation.

The joint AEC-NASA office will be responsible for management of all phases of work to be performed by the contractor selected.

AEC IN-162 release Dec. 60

National Aeronautics and Space Administration, (Sandusky, Ohio)

(Docket 50-30)

October 4 -- The Space Administration filed an Answer And Motion For Continuance of the hearing scheduled for October 18, 1960 (concerning the proposed issuance by the Commission of a facility license for operation of the 60 megawatt, thermal, pressurized water test reactor at NASA's Plumbrook Facility near Sandusky, Ohio).

October 7 -- The Reply Of AEC Staff To Answer And Motion For Continuance was filed.

October 18 -- The scheduled hearing was convened and NASA presented supplemental facts to its request for continuance. The request was granted and the hearing was recessed to December 14, 1960.

October 19 -- An Order Postponing Hearing To December 14, 1960 (10:30 a.m., Commission Headquarters, Germantown, Md.) was issued.

Nuclear Engineering Co., Inc., Pleasanton, Calif.

(Docket No. 27-10)

October 19 -- An Order And Notice Of Hearing was issued, directing a hearing at 9:30 a.m., November 16, 1960, at a place to be designated in San Francisco, Calif., on the application for renewal of Byproduct, Source and Special Nuclear Material License No. 4-3766-1. The issue specified was whether Licensee should be required to change its loading site for radioactive waste materials, now in the vicinity of a water supply intake for the city of Antioch, Calif.

October 19 -- An Order Designating the Presiding Officer for the proceeding was issued; and an Order Designating Time and Place for the Hearing was issued (9:30 a.m., November 16, 1960, U.S. Customs Court, Appraisers Building, San Francisco, Calif.)

(more)

November 8 -- By letter, Licensee filed its Answer and requested that the hearing be limited to the specification of issues set forth in the October 19 Order And Notice Of Hearing.

November 9 -- The State of California, through its Attorney General, filed a petition to intervene.

November 9 -- An Order Permitting Intervention (by the State of California) was issued.

November 10 -- AEC Staff filed a Motion For Prehearing Conference.

November 10 -- An Order For Prehearing Conference was issued, setting 10 a.m., November 15, 1960, U.S. Customs Court, Appraisers Building, San Francisco, Calif., as the time and place for the prehearing conference.

November 15 -- The prehearing conference was held.

November 16-17 -- The scheduled hearing was held. Contra Costa County and the city of Antioch were permitted to intervene at the hearing.

Pacific Gas and Electric Co., (Eureka, Calif.)

(Docket No. 50-133)

October 3 -- Applicant filed Comments On Order Correcting Transcript and Staff's Proposed Findings And Conclusions.

October 17 -- An Intermediate Decision was issued authorizing the construction of a 50 electrical megawatt boiling water reactor power facility at Buhne Point near Eureka, Calif., and authorizing allocation of 2,754 kilograms of uranium 235 for the reactor's operation.

November 8 -- In the absence of any exceptions being filed on review by the Commission on its own motion, the Intermediate Decision became final.

(more)

AEC

UNITED STATES
ATOMIC ENERGY COMMISSION
Washington 25, D. C.

c/d
1/2/61

No. C-248
Tel. HAzelwood 7-7831
Ext. 3446

FOR IMMEDIATE RELEASE
(Friday, December 9, 1960)

AEC EXTENDS COMPLETION DATE FOR NASA TEST REACTOR

The Atomic Energy Commission has extended the latest completion date of the National Aeronautics and Space Administration's research and testing reactor near Sandusky, Ohio, to January 1, 1962. The reactor is being constructed at NASA's Plum Brook facility near Sandusky.

The construction permit for the reactor was issued by the Commission on July 21, 1958, and set forth a completion date of January 1, 1960. This date subsequently was extended to January 1, 1961.

NASA reported to the Commission on November 15, 1960 that additional time is necessary to complete the reactor because of:

"(1) Additional work required on the surface of the reactor tank to eliminate microscopic imperfections which had been rolled into the surface in the fabricator's plant.

"(2) Additional work on piping attached to the reactor tank which was found necessary by NASA.

"(3) Addition of a vent line as required by AEC.

"(4) Installation of a fuel element storage alarm as required by changes in AEC regulations.

(more)

"(5) Difficulty in recruiting certain key qualified personnel who are in short supply."

The Commission will reconvene a hearing on NASA's application for an operating license for the reactor at 10:30 a.m. Wednesday, December 14, 1960. It will be held in the Auditorium of AEC Headquarters at Germantown, Maryland. The hearing was recessed on October 18, 1960 to December 14.

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12960

AEC

UNITED STATES
ATOMIC ENERGY COMMISSION
Washington 25, D. C.

Tech
C-D

No. D-57
Tel. HAzelwood 7-7831
Ext. 3446

FOR IMMEDIATE RELEASE
(Thursday, March 16, 1961)

AEC ISSUES PROVISIONAL OPERATING LICENSE FOR NATIONAL AERONAUTICS AND SPACE ADMINISTRATION REACTOR

The Atomic Energy Commission has issued a provisional operating license to the National Aeronautics and Space Administration for the research and testing reactor at NASA's Plum Brook facility near Sandusky, Ohio.

The license was issued pursuant to the March 3, 1961, intermediate decision by AEC Hearing Examiner J. D. Bond and following public hearings which were held regarding the project.

NASA sought only a provisional operating license for maximum power of 100 kilowatts thermal at this time. The heterogenous, light water cooled and moderated reactor is designed to operate at 60 megawatts thermal and eventually will be used by NASA for, among other things, nuclear systems research applicable to rockets, aircraft propulsion, and flight power generating systems.

Under terms of the license NASA will be permitted to load nuclear fuel in the reactor only after the Director of the Commission's Division of Licensing and Regulation has found that certain required systems or items in the reactor have been constructed and tested and that modifications in the reactor controls have been completed.

Operation of the reactor past the level of one kilowatt thermal may not take place until the Director of the Division of Licensing and Regulation has found that certain other items of construction in the reactor have been completed.

(more)

The provisional operating license was issued to NASA under Section 50.57 of Commission regulations which permits issuance of such a license in a proceeding where construction of the facility has not been completed, but is continuing satisfactorily and there is reasonable assurance that the facility will be ready for initial fuel loading within 90 days.

NASA plans to operate the reactor at the power level of 100 kilowatts thermal while it completes work on the additional items required for operation at the higher power of 60 megawatts thermal.

In November 1960 the Commission's Advisory Committee on Reactor Safeguards considered the proposed operation of the NASA reactor at 100 kilowatts thermal before completion of some portions of the facility. The Committee concluded that it "believes that there is reasonable assurance that the proposed operations can be carried out without undue hazard to the health and safety of the public."

NASA's provisional operating license will expire 18 months from the date of issuance on March 14, 1961 (subject to modification or extension for good cause), or upon the earlier issuance of a superseding operating license by the Commission.

- 30 -

31661

From: PUBLIC INFORMATION OFFICE
LEWIS RESEARCH CENTER
National Aeronautics and Space Administration
21000 Brookpark Road
Cleveland 35, Ohio

For release at 8:45 a.m. EST, Tuesday, March 21, 1961

THE PLUM BROOK RESERVATION -- PAST AND PRESENT

The National Aeronautics and Space Administration's decision to select Plum Brook as the site for the NASA reactor was based on several factors.

One consideration was that the Lewis Research Center, with a large pool of trained scientists and technicians, was located only 50 miles away.

The proximity of Lewis to Plum Brook has made it possible to realize a savings in operating costs, since many essential services are provided by the parent Lewis Center.

The fact that the Plum Brook area was already developed permitted NASA to establish the reactor facility more rapidly and at a lower initial cost than would otherwise have been possible.

Another equally important reason is that Plum Brook is an excellent location for a research reactor: The well-watered site drains toward Lake Erie and drainage can be controlled by dikes. Winds are predominantly from the southwest and blow over a relatively sparsely populated area toward the lake.

Plum Brook and neighboring Sandusky, a Lake Erie city of about 40,000 halfway between Cleveland and Toledo, are served by the Baltimore and Ohio Railroad, the Ohio Turnpike, and other highways.

Originally developed in 1941 and 1942 as the Plum Brook Ordnance Works, the facility was used by the Army in the manufacture of TNT and pentolite and

for ammunition storage. The installation later was inactivated, except for an area used by the Erie Ordnance Depot for ammunition storage. The Government subsequently allocated most of Plum Brook to the Lewis Research Center.

In addition to the reactor, constructed in what was a pentolite manufacturing area, Lewis is building a Rocket Research Facility -- the pilot plant having already been put in operation. Other areas have a dynamics missile stand, portable rig, rocket systems, fluorine pump, turbine, hydraulics, pump and turbopump facilities.

The Plum Brook Reactor Facility consists of several structures and areas:

Reactor Building: Housing the reactor, this is a flat-roofed, mill type building, 29-1/2 feet high and about 150 by 160 feet. Work space is provided for setting up and conducting experiments. The building houses shop and personnel facilities, and control panels for experiments. The reactor control room, and offices, are on a mezzanine extending along the north and west walls. Basement areas are connected by a stairway, and by a passage to the hot laboratory building parallel to the canal used for underwater transport of radioactive material.

Hot Laboratory Building: This is the south wing of the Reactor Building. Nearest the Reactor Building is a 40 by 70-foot hot handling room, where experiments are placed in the hot cells. The canal to the reactor passes through this room, which has 72-inch-thick concrete walls.

Primary Pump House: Adjoining the Reactor Building on the east, the Primary Pump House contains the pumps, heat exchangers, and ion-

exchangers for the primary main cooling system. Thick concrete walls of the pump and ion-exchanger rooms provide sufficient shielding so that any one of them can be serviced while the others are in operation.

Office and Laboratory Building: This structure adjoins the Reactor Building on the west.

Fan House: Located to the east of the Hot Laboratory, this structure contains the ventilating fans for the facility. Twenty thousand cubic feet of air per minute can be furnished to the Reactor Building and more than 13,000 cubic feet per minute can be discharged--after filtration -- through the stack to the east of the Fan House.

Hot Retention Area: This area is south of the Fan House. A 1,000,000 gallon "cold basin" for water of little or no activity from the canals or quadrants is located to the east of the hot retention area. There are eight hot retention tanks of 64,000 gallons each for radioactive water, which can be filtered before reusing or draining into Plum Brook. A 10,000,000 gallon earthen basin the southeast corner of the fenced-in area around the Reactor Facility provides emergency storage for water from the facility.

Effluent Control Station: Surface and waste water is collected by a series of culverts and ditches which lead to the Effluent Control Station, located in the extreme southeast corner of the fenced-in area around the Reactor Facility. The water flow rate is controlled at the station by a series of flumes.

Tanks and Tower: Two overhead tanks in the northeast corner of the site contain processed water and deionized water; a cooling tower and secondary water pumps are to the south of these tanks.

Service Equipment Building: Softening, filtering and deionizing equipment for raw water is contained in this building, which also houses air compressors, electrical control equipment, and the diesel-generators for emergency electrical power. The structure is located between the cooling tower and the Reactor Building.

Electrical Substation: The Ohio Edison Company furnishes incoming electrical power to this substation, which has two 34,500 volt, 3-phase, transmission lines, a 4,160 volt distribution system feeding power to five 750 KVA unit substations, and ten high voltage motor starters. The substation is southeast of the Service Equipment Building.

Weather Station: A 150-foot collapsible tower near the southwest corner of the Hot Laboratory Building has equipment which provides the reactor staff with up-to-the-minute meteorological reports.

From: PUBLIC INFORMATION OFFICE
LEWIS RESEARCH CENTER
National Aeronautics and Space Administration
21000 Brookpark Road
Cleveland 35, Ohio

For release at 8:45 a.m. EST, Tuesday, March 21, 1961

THE PLUM BROOK REACTOR

NASA's nuclear research reactor is part of the Plum Brook research facility located three miles south of Sandusky, Ohio. It is operated by the Lewis Research Center in scientific investigations relative to spacecraft and their components which are being designed for nuclear-power flights.

Future spacecraft will be propelled or powered by nuclear reactors such as those designed for the Snap and Rover systems. The Plum Brook reactor simulates the nuclear radiation environment which is found in such reactor systems. Hence, detailed studies of advanced reactor materials, components, and environment can be evaluated without designing or building the complete system. Component reactor studies would include fuel elements, moderating materials, heat transfer characteristics, and shielding investigations.

The Plum Brook Reactor is a materials testing reactor, light water-cooled and moderated, with a primary beryllium reflector and a secondary water reflector. The initial core will be a 3 by 9 array of fuel elements designed for operation up to a thermal power of 60 megawatts. The curved-plate fuel elements are composed of aluminum-enriched uranium alloy clad with aluminum.

The fueled reactor height is 24-5/8 inches. It is mounted in a vertical, cylindrical, stainless steel clad pressure vessel, 8 feet in diameter and 32 feet high. Three concentric stainless steel cylinders

within the pressure vessel serve as thermal shields. A heavy steel cover above the pressure vessel shields against gamma rays during normal operation and provides protection against damage by shrapnel in the event of an explosion inside the pressure vessel.

The pressure vessel, surrounded by heavy concrete having a minimum thickness of 2 feet, is approximately at the center of a pool of water 70 feet in diameter and 25 feet deep. The reactor core is about 21 feet below the surface of the water, which serves as biological shielding to protect employees and visitors from radioactivity.

The pool is divided by water-tight partitions into four quadrants. A semi-circular canal allows access to two of them through vertical lift gates and to a third through a lift gate in one of the quadrant positions. A vertical lift gate, its top 11 feet below the normal water level, is the entrance to the hot laboratory canal from the outside perimeter of the semi-circular canal--which is also the wall of the containment building.

Each reactor quadrant contains about 180,000 gallons of water. There are about 220,000 gallons of water in each canal. Water in the quadrant and canal areas is partially deionized.

All control rods enter from below the reactor, which is controlled by five control rods in the core and five in a row of the beryllium reflector elements adjacent to the core. Two of the rods in the beryllium reflector are used as regulating rods.

The primary main cooling water system's closed-cycle primary loop transfers reactor heat to a secondary main cooling water system. The reactor's primary shutdown cooling system is designed to have sufficient

capacity to cool the reactor after shutdown.

Test Facilities

All experiments inserted in the horizontal irradiation spaces and any equipment near the test area must be handled under water in the shielding pool before and during irradiation.

After irradiation, a test specimen is transported under water from the shielding pool through a canal to the hot laboratory -- which includes space for underwater and dry storage of radioactive material, areas for dismantling large test sections, and a number of high level hot cells.

Facilities for irradiation experiments around the Plum Brook Reactor include:

1. Two 9-inch-diameter horizontal holes. (One is almost directly against the fuel elements and surrounded by beryllium; the other is separated from the elements by 3 inches of beryllium.)
2. Three 6-inch-diameter horizontal beam holes.
3. Two 8-inch vertical holes entering from the top of the tank and located against the narrow widths of the lattice.
4. Small test holes for irradiations and capsule tests in the primary and secondary beryllium pieces, 2 and 2-1/2 inches in diameter, respectively. (Beryllium plugs will be removed from the center of the pieces and the capsules placed in the holes.)
5. Hydraulic and pneumatic rabbit tubes, 3/4-inches in diameter.

Available Utilities

The following utilities are available to the Plum Brook Reactor:

1. 200 gallons of deionized cooling water per minute, at 165 pounds per square inch.
2. 300 gallons of cooling tower water per minute, at 60 pounds per square inch.
3. 12.5 pounds of air per second, at 100 pounds per square inch and at about 70 degrees Fahrenheit.
4. About 350 KVA at 380 volts, 3 phase, 60-cycle electrical power.
5. About 20 KW at 125 volts, direct current.
6. 208 Y/120 volt, 3 phase, 60-cycle, for general lighting and small power needs.

From: PUBLIC INFORMATION OFFICE
LEWIS RESEARCH CENTER
National Aeronautics and Space Administration
21000 Brookpark Road
Cleveland 35, Ohio

For release at 8:45 a.m. EST, Tuesday, March 21, 1961

HEALTH PHYSICS AT PLUM BROOK

As the Plum Brook Reactor Facility "goes critical" -- and thus becomes operational -- there will go into effect an extensive program designed to guarantee that the facility and its environs will be kept free from radioactive contamination.

Included in the safety program will be a requirement that all persons on the facility premises wear badges of film in frames of various colors -- devices for monitoring an individual's exposure to radioactivity.

These film badges are an indication that Plum Brook has taken no chances on what might be termed the "minimum credible accident" as distinguished from the "maximum credible accident" so carefully guarded against in the reactor design.

The badge registers radioactivity; the smallest amount of it is visible instantly in the changing color on the badge. The wearer can be removed immediately, checked further, and treated if need be. The area can be evacuated instantly, sealed off, and investigated.

Beta-gamma sensitive film badges to be issued to all personnel at Plum Brook are designed for 13 weeks wear -- to prevent undue prejudice to the exposure history of each individual. Some personnel will require neutron exposure monitoring.

Color codes will be used to immediately identify the type of film in the badge, its wearing period, and areas of the reactor facility the wearer is permitted to enter. Batches of film will be exposed to known sources of radiation periodically as a quality control measure.

As an auxiliary monitoring device, all persons working with radiation sources will receive pocket dosimeters -- which obviate the necessity for processing film packets when it can be shown that no credible exposure occurred to the wearer.

Personnel monitoring instruments will include door scanners, hand and shoe counters, count rate meters with cables and probes, and portable survey meters. As a further check, biological specimens will be collected routinely at Plum Brook, with frequency depending upon real or potential exposure and the work history of the individual concerned.

Facility monitoring will consist of air and water sampling: Air samples will include those from the reactor stack; water samples will include effluent water, water from wells, cooling tower water, and canal and quadrant water. In addition, smear techniques will be employed to detect radioactive materials deposited on building surfaces and equipment; and portable instruments will be taken to areas where work involving ionizing radiation or toxic materials creates hazards to personnel.

The area within the fences of Plum Brook will be monitored periodically to include a study of air, water, vegetation, and small animals. Within a 9-mile radius of the Plum Brook fence, samples of air, water, and milk will

be taken at selected points and studied in the light of rainfall, wind direction, season of the year, and reactor operation.

In connection with the safety program, weather information obtained from local and regional U. S. Weather Stations will be used in conjunction with data collected at the facility's meteorological tower. The tower will be instrumented to record wind speed and direction at three levels, the temperature difference between the base, midplane, and top, and the ambient temperature from near the ground level.

Controls for Radiation, Inc., of Cambridge, Mass., a firm of experts, is under contract to the Lewis Research Center to perform all the services required in the program to keep the Plum Brook facility and its environs free from radioactive contamination.

These services include monitoring activities and surveys, storage and dispensing of protective clothing and equipment, laundry service, janitor service, special nursing and first aid, control of all shipments of radioactive materials and wastes, escort service, laboratory testing of air, water, vegetation, and other samples, weather observation, repair and calibration of all instruments required, and related duties.

Some of the laboratory services will be provided at the contractor's facilities in Cambridge, including film badge processing, strontium-90 milk analyses, specialized bio-assays, and environmental sample analyses.

Two control posts manned by the contractor, one at the reactor entrance and the other inside, will be used to issue and collect film badges and pocket dosimeters, keep logs, and assure that materials and equipment have been properly

cleared for release.

The Controls for Radiation, Inc., is under a fixed-fee-and-cost contract. The Cambridge firm will receive a fixed fee of $12,500 a year for services. Costs are estimated at about $250,000.

From: PUBLIC INFORMATION OFFICE
LEWIS RESEARCH CENTER
National Aeronautics and Space Administration
21000 Brookpark Road
Cleveland 35, Ohio

Release for PM's Tuesday, March 21, 1961

Sandusky, Ohio, March 21---

The Plum Brook Research Reactor, the Nation's newest facility designed especially for research of nuclear power system components, will begin operation early next month under the direction of the National Aeronautics and Space Administration.

This was announced today by Dr. John C. Evvard, Assistant Director of NASA's Lewis Research Center, Cleveland, Ohio. The reactor is part of Lewis, the principal propulsion research center of the NASA.

"We have received our license to operate the reactor from The Atomic Energy Commission and are about to begin using it on a low power calibration basis," Evvard said. "This means that following several months of successful low power operation the physicists and technicians can move on to the full design power of 60 million watts."

Evvard met this morning with newsmen and representatives of federal and state governments, and officials from the City of Sandusky and Erie County, prior to a tour of the new reactor. "The task of research in propulsion technology is most formidable and requires careful, long range planning," he said. "Planning for the Plum Brook Reactor began more than five years ago."

The reactor will be an invaluable tool for the study of components and materials under radiation conditions similar to those anticipated in full-scale nuclear-powered systems for spacecraft -- components such as pumps, turbines, shielding, and

propellant feed system. In operation, the Plum Brook reactor will simulate on the ground under controlled conditions the radiation environment of nuclear power plants, of which the SNAP and ROVER projects are examples.

One of the experiments scheduled for early investigation is the effect of radiation on materials at the extremely low temperatures of propellants, such as liquid hydrogen, which will be used in atomic powered systems. Another experiment will determine the effects of radiation on material corrosion rates at high temperatures. Still other studies will be made to determine effects of radiation on sensitive electronic components.

The Atomic Energy Commission contributed greatly to the reactor project. Lewis engineers designed the facility in close consultation with the AEC in all phases of the work. Exhaustive studies were made to insure against every possible hazard to employees or residents of the reactor area. AEC and NASA will continue cooperation in the Plum Brook programs.

Construction of the complex facility was begun in September of 1956 under the direction of James R. Braig and the late M. V. Organ, both of Lewis. It is now virtually completed. Engineering design was under the direction of Samuel J. Kaufman, Lewis scientist. Total cost was about $15,000,000. Operated as part of Lewis under Leroy V. Humble, Chief, Nuclear Reactor Division, the facility has a staff of 100, headed by Dr. Theodore M. Hallman, Chief, Plum Brook Reactor. Alan D. Johnson, Chief, Reactor Operations Branch, was responsible for design of the reactor's control system.

From: Public Information Office
Lewis Research Center - NASA
21000 Brookpark Road
Cleveland 35, Ohio

RELEASE FOR PM'S TUESDAY, MARCH 21, 1961

Following Are Remarks By Dr. John C. Evvard, Assistant Director, Lewis Research Center - NASA, On The Occasion Of The Plum Brook Reactor Press Meeting, Sandusky High School, Sandusky, Ohio, March 21, 1961.

* * * *

Good morning ladies and gentlemen, Congressman Mosher and distinguished guests. My name is John C. Evvard; I am Assistant Director of the Lewis Research Center. I speak for Eugene J. Manganiello, Acting Director, who unfortunately could not attend because he underwent minor surgery yesterday. I am happy to welcome you to the opening ceremonies and tour of the Plum Brook Reactor facilities.

I would like to take this opportunity to thank the Sandusky Chamber of Commerce for their very cordial champaign GNE. cocktails and buffet dinner of last evening. This fine affair plus their honoring dinner of May 7, 1960, have made us feel most welcome in this progressive community. It goes without saying that we are also grateful to the Sandusky school system for their cooperation and use of the high school facilities.

The National Aeronautics and Space Administration for which I speak is charged with the responsibility of (1) carrying out research into and the solution

of, problems of flight within and outside of the earth's atmosphere; (2) the development, construction, testing and operation for research purposes of aeronautical and space vehicles, and (3) such other activities as may be required for the exploration of space.

In fulfilling these responsibilities the NASA operates seven major field centers including the Jet Propulsion Laboratory and hires nearly 20,000 employees.

The Lewis Research Center located in Cleveland is charged with propulsion research under the Office of Advanced Research Programs. Our task is to originate and evaluate the propulsion systems of the future. Our research studies may precede the propulsion applications by 5 to 20 years. We are presently engaged in advanced studies of chemical rockets, of nuclear propulsion, of electric propulsion, of space power generation and energy conversion systems, of fluid systems and of advanced materials research.

I would now like to present a brief movie showing an aerial view of the Lewis Research Center and the Plum Brook Reactor Facility.

You might ask why we should desire nuclear or electric propulsion systems when the chemical rockets are so effective in our early explorations of space. These chemical rockets require nearly one hundred pounds of take-off weight for each pound of payload in orbit. Most of this weight is fuel. For manned trips to the other planets, the fuel requirements are so large as to be out of hand; in other words the payload would be too small to be useful.

This disadvantage can be overcome by using a higher jet velocity which allows lower fuel consumption. With the nuclear rocket, roughly twice the jet velocity of a chemical rocket is possible. With nuclear powered electric propulsion

perhaps 10 to 20 times the jet velocity of the chemical rocket can be employed. For a manned mission to Mars, either the nuclear or the electrically propelled spacecraft requires only one fifth of the orbital take off weight of the chemical rocket.

The Plum Brook Reactor is one of the nation's major facilities for studying the problems associated with nuclear powered flight. This facility will produce the necessary neutron and γ radiation environment that might be experienced in the vicinity of a nuclear powered space system. Thus we can expose exploratory materials to the extreme temperatures, flow conditions, and radiation damage that they might experience in advanced reactor systems. Thus many of the difficulties that might occur in an advanced prototype nuclear system can be discovered and eliminated before the prototype is either designed or built. Of course the primary responsibility for the design of the prototype nuclear reactor lies with AEC and with industry. Our experiments allow us to anticipate advanced nuclear space flight systems so that NASA can establish the proper mission requirements and specifications for the nuclear reactor systems that AEC would later design and construct. The Plum Brook Reactor also provides the opportunity to conduct fundamental research on bulk shielding, fundamental radiation damage studies on materials, and exploratory studies of neutron defraction, nuclear physics, etc.

I now present a slide showing an aerial view of the Plum Brook Reactor facility.

The Plum Brook Reactor is light water cooled and moderated, it has a primary reflector of beryllium and a secondary water reflector. The water coolant system

is a closed loop in which highly purified water flows from the core through heat exchangers. The heat is picked up by a secondary water system and is rejected by means of a cooling tower. The reactor will operate up to a power level of 60 Megawatts. The design of the facility incorporates three main features: (1) safety (2) containment and (3) continuity of operation.

The reactor site is a 500-acre plot on the north side of Plum Brook Ordnance Works and is about $3\frac{1}{2}$ miles from the outskirts of Sandusky. Water is supplied from one of two pump stations, each located about 1 mile offshore and separated from Sandusky Bay by Cedar Point. The raw lake water will be stored on the site in a $5\frac{1}{2}$-million gallon reservoir. Drainage from the site will be through a drainage ditch to Plum Brook into the Bay area then to the lake.

The reactor facility is located in the south central portion of the 500 acre area. The minimum distance to the public will be 3,000 feet (to the Ordnance fence). Ground water run-off will be controlled by a system of dikes and ditches surrounding the facility. The ground water will be impounded by the dikes and released to Plum Brook through a monitored discharge.

The reactor facility includes the following:

(1) The Reactor Building which houses the reactor, containment tank, storage canal and control rooms. There are 3 wings off the Reactor Building. These house the office, and low-level chemistry and physics laboratories, a high level hot laboratory for handling irradiated experiments, and a primary pump house.

(2) In addition, there is a service equipment building which houses the water purification plant, diesel generators and air compressors. There are 2

overhead water storage tanks; one 100,000-gallon for processed water, the other 60,000-gallon for deionized water. There is also a cooling tower and an electrical substation. Additional facilities include a cold retention basin with a capacity of 1 million gallons, 8 hot retention tanks with a total capacity of $\frac{1}{2}$ million gallons, a fan house and stack, and an emergency retention basin with a capacity of about 10 million gallons.

The dimensions of the reactor building are approximately 160 feet by 150 feet. Shop and office space are provided on the north and west walls. The control room for experiments is on the first floor in the northwest corner, and the reactor control room is directly above on the mezzanine level.

Located in the center of the reactor building is a 3/4'' thick containment vessel. The containment vessel is a 100-foot diameter tank rising 28 feet above grade on the sides and with an additional 25 feet to the top of the dome. The containment shell below grade surrounds the entire bottom including the subpile room and its access passage. A 100-foot circular crane gives full coverage inside the containment tank.

The containment tank can be entered through either of the 2 air locks. Each air lock consists of a double set of mechanically interlocked doors, which prevents either door from being opened unless the other is closed and latched. In addition, a truck door will provide access when the reactor is shut down. This door cannot be opened when the reactor is in operation.

Inside the containment tank there is a retaining wall 70 feet in diameter. The primary pressure tank is at the center. The water-filled annular space between the two tanks is divided into 4 quadrants. The thickness of biological shield in

three of the quadrants is 2 feet of high-density concrete plus the water, and in the fourth quadrant, the shield is 9 feet of high-density concrete. This quadrant will be used for shielding studies. A concrete pad is cantilevered out over the primary pressure tank concrete shielding to provide work space at grade level.

The reactor core is a 3 x 9 array of fuel elements. Each fuel element is approximately 3 inches square by 3 feet long. The centerline of the reactor core is 21 feet below grade. The primary pressure tank houses the core and is surrounded by a biological shield composed of both concrete and water. A combination shrapnel and biological shield covers the pressure tank. There is an annular work space at grade level and at the minus-25-foot level.

The reactor control rods are actuated from below the core with the control rod mechanisms housed in a subpile room.

Most of the annular area between the 70-foot retaining wall and the 100-foot containment vessel at grade level and at -25 feet is dry work space. The remainder is isolated by bulkheads and will be flooded during shutdown for underwater transportation of irradiated materials.

Physics experiments will be run in the north quadrant, shielding experiments in the south quadrant, and pumped loop experiments in the east and west quadrants. Irradiated experiments will be transported under water from the east and west quadrants through sluice-gate, underwater doors opening into the annular canal, then through another under-water opening in the containment tank, and through the canal to the hot handling facility. The transportation and handling of experiments will be discussed again later. A storage canal branches off the main canal and will be used for storage of spent fuel elements, and for a

zero power mock-up of the reactor core for the determination of criticality and the reactivity effects of experiments in the reactor.

Pressure tank - The core is housed in the primary pressure tank. The tank is a stainless steel clad tank, 9 feet in diameter and 32 feet high. The upper end is flanged so that it can be removed. A hatch for refueling and the insertion and withdrawal of small irradiation experiments is also provided in the top of the tank. Instrumentation tubes pierce the tank at the bottom of the quadrants. A thermal shield surrounds the core inside the pressure tank. As mentioned before, the control rods are actuated from the subpile room through packing glands at the top of the subpile room. The upper end of the control rods contain cadmium, which is a strong neutron absorber. The bottom section will contain either fuel or beryllium depending on the location in the core. In order to make the reactor "go critical", the cadmium section is slowly removed from the core by the actuators in the subpile room. In case of power failure or any emergency, a "Scram" latch which is located above the packing gland will cause the rods to drop into their fully inserted position, free of the friction of the packing glands, thus making the reactor sub-critical.

Test facilities - The test facilities for the area around the reactor core consist of:

(1) 2 horizontal through holes 9 inches in diameter. One almost directly against the fuel elements and surrounded by beryllium; the other separated from the elements by 3 inches of beryllium.

(2) 3 horizontal beam holes 6 inches in diameter.

(3) A thermal column 42 inches in diameter.

(4) There are two 8-inch vertical holes running from the top of the tank and located against the narrow widths of the lattice.

(5) In addition, small test holes for irradiations and capsule tests will be provided in the primary and secondary beryllium pieces. Beryllium plugs will be removed from the center of the pieces and the capsules placed in the holes.

(6) Hydraulic and pneumatic rabbit tubes will also be placed near the core.

Main building wings -

The Physics and Chemistry Laboratories are located in the West Wing, and the Office section across the "Tee".

The hot handling section and hot cells are in the South Wing. The canal permits the experiments to be transported into the hot laboratory under water. There is space for underwater storage and for dry storage of hot material, a cell for dismantling large test sections, and a cell equipped with a remote-operated lathe and milling machine. In addition, a number of high level cells are provided in the southern section.

The East wing contains the primary pump house. Each pump is shielded so that maintenance work may be performed on a pump while the reactor is in operation.

METHOD OF HANDLING PUMPED LOOP EXPERIMENTS

Let us now examine a reactor experiment. The largest and most complex experiment to be run in the reactor is the pumped loop. Since material placed in the reactor will generate heat, a complete pumped loop is necessary. That is, to say, all the equipment necessary to cool the test specimen, all of the instru-

mentation necessary for running the experiment, and all of the devices necessary to insure safety, must be supplied with each test. In the Plum Brook reactor, all of the equipment will be "canned" into a single unit, tested "out-of-pile" and then placed in a test hole of the reactor for irradiation. The test specimen is surrounded by concentric stainless steel tubes. The coolant gas enters the annulus formed by the inner and middle tubes, and flows past the test section where it reverses direction and flows back through the test specimen.

The equipment for circulating the coolant and removing the heat is sealed in a tank. The pumping system includes 2 compressors operating in parallel and pumping twice the required flow. One-half is bypassed through a throttling valve and cooler. The remainder cools the test specimen. The coolant gas leaves the element and passes through 2 water-cooled heat exchangers in series, then through a monitored filter and returns to the compressors. Failure of one compressor or heat exchanger will allow the reactor and test loop to be shut down slowly and safely since there is enough capacity in each unit to cool the experiment.

This experiment will be located under water in one of the quadrants. After it has been run, it must be transported, shielded, to the Hot Laboratory.

Working from a bridge, the "canned" experiment is unlocked from the test hole. It is then moved back into the quadrant on rails. The annular canal is then flooded and a sluice gate is opened in the 70-foot diameter retaining wall, permitting the experiment to be moved through the door and into the canal on a transportation dolly. The canal water is utilized as the shield during the transportation. This transfer procedure is then repeated through a similar

opening in the containment tank, and the experiment is moved into the Hot Laboratory.

The experiment is then lifted out of the water by a crane, operated remotely, and placed at grade level with the test section protruding into a large dismantling cell.

The test specimen will then be removed by means of remote-operated equipment, and manipulators. The dismantling cell is large enough to take the entire test rig if necessary.

The test specimen will then be passed into adjoining cells where it will be examined. Specimens will be taken for metallographic analysis and study.

A new test specimen will then be placed in the loop. The procedure will then be reversed to get the experiment back to the reactor for re-insertion and another test.

SUMMARY

By way of recapitulation, the reactor core consists of aluminum-uranium fuel elements in a 3 x 9 grid. The core is reflected by a primary beryllium reflector and by water as a secondary reflector. Pumped loop and other large experiments will be irradiated by placing them around the core in the reflector zones by means of thimbles piercing the pressure tank and opening into the water quadrants. Water in the quadrants will shield the auxiliary equipment.

A method for transporting irradiated experiments is provided by a canal system that permits transfer of hot material from the reactor to the hot laboratory, using canal water as a biological shield.

The reactor is totally enclosed in a containment shell which is sealed during

operation and can be entered only by means of air locks. The Reactor Building is the center hub of facilities surrounding the reactor. These facilities include the high level hot laboratories, low level chemistry and physics laboratories and office section, and the primary pump house.

Pumped loop studies are of particular importance to the research effort necessary in the utilization of nuclear energy for propulsion since they simulate most of the conditions that would exist in flight. Thus, preliminary experiments may be conducted to eliminate many of the potential points of failure in a reactor system prior to its design.

An attempt has been made in the design of the NASA reactor facility to simplify studies of large pumped loops by incorporating the following design features. The reactor is provided with only sufficient solid shield for the shutdown period. During the operating period, the remainder of the shield is provided by a pool of water that surrounds the solid shield. The water also covers and provides shielding for the pumped loop equipment which resides in the water pool. Because the solid shield is thin, the loop equipment can be closely coupled to the experimental portion in the reactor. To expedite the handling of loop experiments, they will be completely enclosed in water tight containers and handled as complete self-contained units. During removal of a pumped loop experiment, a continuous water shielded passage is provided to the storage and hot cell areas so that irradiated experiments can be handled without shielding coffins.

- END -

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
Washington 25, D. C.

RELEASE NO. 61-133

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June ~~15~~ 14, 1961

PLUM BROOK REACTOR GOES CRITICAL

SANDUSKY, OHIO, JUNE 14 -- The National Aeronautics and Space Administration's Plum Brook Reactor began operating today on a low power calibration basis. The reactor a test facility of NASA's Lewis Research Center, Cleveland, is designed especially for the study of nuclear power system components. It was completed last March.

E. J. Manganiello acting director of Lewis said, "We are now using the reactor at low power to calibrate all instruments and equipment. This means that at start-up today the reactor registered a few watts. Over a period of several months this will be increased gradually to a maximum of 100 kilowatts. Then the reactor will be shut-down for ~~infal~~ final inspection."

The NASA executive explained that during shut-down the reactor would be subjected to a final inspection by the Atomic Energy Commission. The shut-down period will total about 30 days and then the reactor will be turned on with a long-term objective of reaching the full design power of 60 million watts.

"The task of research in nuclear propulsion technology is most formidable and requires careful long-range planning" Mr. Manganiello said. "For example, planning for the Plum Brook Reactor began more than five years ago" he added.

The reactor is an invaluable tool for the study of components such as pumps, turbines, shielding and propellant feed systems, and materials under radiation conditions similar to those anticipated in full-scale nuclear-powered systems for spacecraft. In operation the Plum Brook Reactor will simulate on the ground, under carefully controlled conditions, the radiation environment of nuclear power plants such as SNAP and Rover.

One of the experiments scheduled for early investigation in the reactor following achievement of full power is the effect of radiation on materials at the extremely low

temperatures of propellants such as liquid hydrogen which will be used in atomic powered systems. Another experiment will determine the effects of radiation on material corrosion rates at high temperatures. Still other studies will be made to measure effects of radiation on sensitive electronic components.

The Atomic Energy Commission contributed materially to the establishment of the Plum Brook Reactor. Lewis engineers designed the facility in close consultation with the AEC. The AEC and NASA will continue cooperation in the Plum Brook programs.

Construction of the complex facility began in September of 1956 and total cost upon completion was about $13,000,000 million. The reactor has a staff of more than 150 including contractors. These are engineers, physicists, technicians and others.

- END -

Public Information Office
NASA Lewis Research Center
Cleveland, Ohio 44135
252-7700, ext. 415

October 1, 1963

PLUM BROOK STATION

LEWIS RESEARCH CENTER

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

The Plum Brook Station of the Lewis Research Center, National Aeronautics and Space Administration, is a diversified, rapidly-growing test facility located on a 6,000-acre site just outside Sandusky, Ohio.

Plum Brook has a vital role in Lewis' mission of research and development of advanced propulsion and space power systems, a field in which the Center long has been an acknowledged leader.

Housed at Plum Brook are a nuclear reactor and rocket systems research facilities. The work at the installation falls into two general categories:

(1) Studies employing the reactor in basic research experiments associated with NASA's plans to develop a nuclear rocket for future interplanetary exploration, and the development of components and systems for space nuclear auxiliary and main propulsive power.

(2) Test program to study complete rocket engines and components with high-energy propellants, often called "exotic fuels."

THE BEGINNING

The land occupied by the NASA Plum Brook Station was acquired from the Army through a gradual lease and then transfer process. The first parcel--500 acres--of the giant site was leased to NASA by the Army in March 1956.

(more)

The Army had established a TNT manufacturing plant on the site during World War II. It was called the Plum Brook Ordnance Works after a small stream that meanders through the acreage. At the height of TNT manufacturing activity, 6,000 persons worked around the clock on 12 production lines. After the war, the installation was "mothballed" by the Army.

The site remained virtually unused until officials of the Lewis Research Center in Cleveland became interested in it while looking for a suitable location for a test reactor.

Plum Brook was selected over some 20 other possibilities because of several factors. They included good drainage to Lake Erie and proximity to the parent Center--about 50 miles--with its large pool of trained scientists and engineers. Additionally, the fact that Plum Brook was already developed allowed establishment of the reactor facility more rapidly and at a lower initial cost.

Ground was broken for the reactor in October 1956. Later, rocket test facilities were built as additional parcels of the site were leased to NASA. NASA assumed control and title of the entire site with the final transfer in March 1963.

THE NEAR FUTURE

Presently Plum Brook is a picture of contrast as the "ghost towns" and "igloos" (storage bunkers) of TNT days give way to a continuing construction program for space research projects. Two contracts for clearing away unusable and obsolete ordnance works buildings from the site were awarded in July 1963.

Some $40-million worth of new construction at Plum Brook is moving ahead on schedule. The building program, authorized by Congress in the fall of 1962, will virtually double the Government's investment at the Sandusky site. Included are:

- Space Propulsion Facility, costing an estimated $25.6 million. This facility, which will have a 100 by 120 foot cylindrical space environment chamber, will simulate pressure and temperature conditions

(more)

existing at altitudes up to 100 miles above the earth and will be used for evaluation and testing of complete spacecraft, including the operation of nuclear-electric propulsion systems.

- Spacecraft Propulsion Research Facility, estimated $6.2 million. This facility, commonly called B-2 Site, will be an environmental simulation firing stand. It will provide vacuum and cold walls to simulate space environment for testing the effects of such an environment on upper-stage engines or on space vehicles.

- Nuclear Rocket Dynamics and Control Facility, estimated $3.5 million. This facility will be a 200-foot high stand, designated B-3 Site. It will be used for non-nuclear tests of various components of large nuclear rocket engines such as will be needed for interplanetary travel.

- Hot Hydrogen Heat-Transfer Facility, estimated $2.4 million. This facility will allow testing of rocket nozzles for future nuclear-propelled spacecraft. The facility will produce hydrogen gas at temperatures of 4,000 degrees F. and thus simulate the exhaust temperatures of a nuclear rocket engine.

- Modernization of Plum Brook Service Facilities, estimated $1.5 million. This includes an addition to the office building at the nuclear reactor site; modernization of a maintenance building; control building addition and five small shops.

- Alterations for a test stand to accommodate testing of the Atlas-Centaur-Surveyor combination, $870,000. This work, which included raising the roof of the stand 20 feet to a height of 130 feet, is completed.

Employment at Plum Brook, presently around 540 persons, is expected to reach 620 by the end of fiscal year 1964.

Heading up the staff and activities at the Sandusky station is Alan D. Johnson. Associated with Lewis Research Center since 1944, Johnson was Chief of the Reactor Operations Branch prior to his appointment as Plum Brook Director.

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THE PLUM BROOK REACTOR FACILITY

Plum Brook's research reactor develops 60,000 kilowatts of thermal power when operating at full capacity.

It is an invaluable tool for the study of materials and components--such as actuators, pumps, turbines, shielding, and propellant feed systems--under radiation conditions similar to those anticipated in full-scale space nuclear-rocket systems.

THE REACTOR

The reactor is a light-water cooled and moderated reactor. Its core is approximately a 30-inch cube. The core holds 27 fuel elements, which are composed of an enriched uranium-aluminum alloy clad with aluminum, and suitable supporting structures.

At full power the reactor has a thermal flux density of 4×10^{14} neutrons per square centimeter per second. (That is to say 1,000,000 times 1,000,000 times 100 neutrons are passed through a square centimeter of a test sample's surface every second).

The full power cycle lasts 10 days. Then the reactor is shut down for 11 days.

The reactor is controlled by five control rods in the core and five in a row of the beryllium reflector elements adjacent to the core. Two of the rods in the reflector are used as regulating rods. All of the control rods enter the reactor core from the bottom.

The reactor is shut off by releasing the control rods so that they fall by gravity into the core. Failure of any component or electrical power during reactor operation will automatically release the control rods and thus stop the production of heat and neutron radiation.

The core is surrounded by a primary beryllium reflector and water as a secondary reflector. The core is under 21 feet of water during operation.

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THE PRESSURE VESSEL

The reactor is mounted in a vertical, cylindrical, stainless steel-clad pressure vessel, 9 feet in diameter and 32 feet high. Three concentric stainless steel cylinders, located within the pressure vessel, provide a thermal shield.

Above the pressure vessel are three 20-ton steel covers which serve as a gamma ray shield during normal operation and as a shrapnel shield in the remote event of an explosion inside the vessel.

The pressure vessel is surrounded by walls made of high-density concrete. Minimum thickness of these walls is two feet.

The vessel is at the center of a pool of water 70 feet in diameter and 25 feet deep which serves as biological shielding. The pool is divided into four quadrants by water-tight partitions.

A semi-circular canal is located adjacent to several of the quadrants and permits access to two of them through vertical lift gates, and to a third via a lift gate in one of the quadrants.

Another lift gate in the wall of the canal provides access to an extensive system of 25-foot deep water channels leading from the reactor throughout storage and hot laboratory areas. Thus a constant water shield is maintained as radioactive test materials are mechanically removed from the reactor and taken to storage or the hot laboratories.

Three-million gallons of water per day are circulated through the system when the reactor is operating at full power.

SOME SAFETY FACTORS

The reactor core, pressure vessel, water quadrants, and semi-circular canal are all located within a huge steel containment shell that is 100 feet wide, 53 feet high and stretches below ground level 56 feet.

This virtually leak-tight containment shell is one of the more impressive safeguards against accidental release of radioactive contamination. The only

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breaks in the shell are those necessary for electrical lines, pipe penetrations and doors. Air leakage, which is less than 0.005% per day of the total contained volume, is kept under constant surveillance.

In the hot labs, materials tested in irradiation experiments are handled by remote-controlled huge mechanical hands. Operators view their work through multiple-layer lead glass windows approximately four feet thick.

The water used in the reactor system and any contaminated equipment and materials are held in hot storage until their radioactivity has been reduced to levels set as safety standards by the Atomic Energy Commission.

EXPERIMENTS

Experimental facilities in the reactor design include a thermal column and "beam" and "through" holes to allow radiation of varying energies to reach test materials.

Experiments are classified into four general categories: nuclear rocket systems and components, radiation effects, basic physics, and energy conversion.

On July 17, 1963, the reactor reached criticality for the first experimental cycle conducted at the facility. Six experiments are the first involved.

One, under contract to the Lockheed Aircraft Corp., is studying the effects of neutron bombardment on small samples of various alloys in a cryogenic (extremely cold) environment.

Alloys of stainless steel, aluminum, and titanium are irradiated in a liquid helium atmosphere at more than 400 degrees below zero--a temperature range that causes most metals to become brittle. The alloys are stretched and deformed to test their strength in this forbidding environment.

Such data about metals and materials are essential to NASA's plans to build a nuclear rocket for interplanetary exploration. In a nuclear rocket, metals and materials will encounter cryogenically cold temperatures from space and liquid fuels onboard and radiation from the rocket's powerplant and cosmic radiation.

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A second experiment, in which the Westinghouse Electric Corp. is participating, is monitoring the reliability of data sensors, such as strain gauges and resistance thermometers, while under irradiation.

This program is in support of the KIWI project, being conducted by the AEC. KIWI, concerned with testing nuclear rocket reactors, is part of the NERVA (nuclear engine for rocket vehicle application) project.

This second experiment will be expanded later, it is planned, to include the testing of many nuclear rocket components in a neutron bombardment and cryogenic environment.

There are also four less complicated but important material irradiation tests being conducted.

FUTURE TESTING

So far requests for irradiation of 25 experiments have been approved for the reactor. This number is expected to increase significantly as reactor operation continues.

In one experiment planned for the future, a steel disc coated with a solid-film lubricant, molybdenum disulfate, will be irradiated to examine the characteristics of the lubricant in a radiation environment. This experiment will utilize one of the core's beam holes.

One through hole is scheduled for use in a NERVA piston actuator experiment. In a nuclear engine, the heat variation from the core of the reactor to the external walls is tremendous. Determining the operation of the piston under divergent but simultaneous heat and neutron bombardment conditions will be a major experiment.

THE MOCK UP REACTOR

In addition to the main Plum Brook Reactor, there is within the complex a low power (100 kilowatt), low pressure device designated the Mock Up Reactor.

The Mock Up Reactor (MUR) is an experimental tool designed to assist the operation of the main reactor.

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The MUR will be used to determine the effects of experiments on the radiation flux and reactivity in the core of the main reactor. Other tasks include aiding in the design of experiments for the main reactor and providing radiation effects data in tests not requiring such high fluxes.

The low power device is similar in all design aspects to the Plum Brook Reactor--physical size, amount of uranium in the core, etc.

The MUR is commonly called a "swimming pool type" reactor. This comes from the fact that the reactor, because of its low power and low pressure, requires only water shielding to contain its radioactive output. During operation the core will be under 15 feet of water. Should the water level fall to 14 1/2 feet over the core, electronic devices will automatically cut the reactor's power back to zero.

HISTORY

Ground was broken for the Plum Brook Reactor Facility in October 1956. Lewis engineers designed the facility in close consultation with the Atomic Energy Commission in all phases of the work. Exhaustive studies were made to insure against every possible hazard to employees or residents of the reactor area. Construction of the $15 million facility was completed in March 1961.

The reactor began operating at low power for test and calibration in June 1961. Both non-nuclear and low power testing were completed in 1962. AEC authorization for a full power go ahead was granted in January 1963.

The reactor reached 60,000 kilowatts for the first time in April 1963.

The Mock Up Reactor was licensed for operation by the AEC in August 1963. The following month the MUR went critical for the first time.

Chief of the Reactor Division is H. Brock Barkley, Jr. Barkley was formerly Reactor Officer at the U. S. Navy's Idaho Facility, which developed the prototype power plants for the first nuclear submarines and surface ships. He was supervisor of the Space Power Section, Bendix Systems Division, at the time of his NASA appointment.

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ROCKET SYSTEMS RESEARCH FACILITY

Conducting live rocket engine tests and the evaluation of the various engine components and new high energy fuels, is one of the two major research functions at Plum Brook.

At the Rocket Systems Research Facility, NASA scientists are studying the more exotic high-energy fuels, such as liquid hydrogen and liquid fluorine. Both of these produce considerably more thrust from a similar quantity of fuel than propellants presently employed.

Such problems as devising new nozzles to withstand the extreme heat resulting from the burning of high energy fuels--as high as 6,000 degrees F.--are being studied at this facility.

In line with nuclear rocket work, there is also emphasis on perfecting methods to shield such fuels from the heat of radiation produced by nuclear rocket engines.

A parallel program involves research into new types of turbopumps for use in high-energy chemical engines and nuclear rockets.

Existing research facilities and their functions are:

A Site--

Pump Test Area--houses two fluid transport "loops" into which test pumps can be inserted to determine their performance under the rigorous conditions of fast flows with cryogenic liquids.

One loop is designed to test pumps with liquid hydrogen, the other with liquid oxygen. The liquid hydrogen loop has a flow rate of 100 pounds per second, the liquid oxygen 250 pounds per second.

B Sites--

B-1--Nuclear Rocket Engine Dynamics or NERVA stand--where 15-second to 30-second tests will be conducted on the propellant system start-up characteristics of the NERVA (nuclear engine for rocket vehicle application).

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B-2 and B-3 Stands are among the new construction projects discussed at the beginning of this fact sheet.

C Site--

Turbo Pump Test Area--is equipped to conduct two simultaneous experiments on pumps.

A liquid hydrogen boiling fluids pump being tested at this site is designed to help solve one of the most urgent problems in space research--that of storing and using hydrogen fuel over long periods of time.

In any rocket engine, and especially in a nuclear engine, a tremendous heat flow from the engine will reach the fuel tanks. Should this heat cause the fuel to actually boil, thus producing gas, the pumps would be required to handle a gas-liquid mixture that might cause them to stall or vapor-lock. Experience with boiling fluids and improved pump designs at this site is aimed at preventing possible pumping problems.

The other experiment involves a research pump for inlet studies with liquid hydrogen. The pump is now operating at a capacity of 10 pounds per second. It is capable of carrying as much as 60 pounds per second.

D Site--

Turbine Test Area--is designed for research and development of turbines of the type needed to drive propellant pumps for chemical and nuclear rocket engines.

This facility has gas generators to provide hot working fluids for tests and dynamometers capable of measuring power from turbines up to 15,000 horsepower.

E Site--

Dynamics Research Test Center--is being used for ground tests of the Atlas-Centaur-Surveyor combination, which is slated to place a soft-landing instrument package on the moon prior to manned lunar exploration.

An Atlas booster is now mounted in the stand, where NASA engineers, using a complicated system of stanchions and cables, will apply crushing forces to the vehicle similar to what would be encountered during an actual Atlas-Centaur mission.

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A Centaur test vehicle will be mated to the Atlas followed by a dynamic test model of the Surveyor spacecraft. NASA engineers will subject the complete flight system to ground tests to determine how the vehicle will behave during actual flight.

The ground tests will include tanking with simulated propellants and severe shaking of the vehicle to test its structural strength. The stand is equipped with two electromagnetic devices called "shakers" which can shake test vehicles vertically and horizontally.

Centaur is the nation's first high-energy fuel space vehicle (hydrogen and oxygen), and has been assigned the country's highest development priority.

F Site--

Hydrogen Flow Laboratory--allows both cryogenic and non-cryogenic fluids to pass through any desired test set-up for fluid flow research and studies of component parts.

G Site--

Pilot Plant--was the first operating facility at Plum Brook. It is a dual site capable of small-scale pump and turbine research. The pump rig is being rebuilt to support axial flow liquid hydrogen pump tests.

H Site--

Central Control Building--contains remote control instruments for all but two sites--B and J--and data recording instruments for all sites. Closed-circuit television allows operators to keep constant check on experiments--which may be taking place at a site as much as a quarter mile away.

I Site--

Liquid Fluorine Pump Laboratory--is equipped to handle liquid fluorine flows at rates up to 50 pounds per second.

Fluorine is the most active oxidizer known. As such it has great potential in the field of rocketry. Fluorine's properties and methods for handling it is its cryogenic form are studied at this site.

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J Sites--

Rocket Test Area--has many diverse functions.

J-1 is a hot firing rocket stand currently being used for rocket nozzle heat transfer studies. Gaseous hydrogen and liquid oxygen are burned at J-1 to simulate rocket engine operation. Hot gas (up to 6,000 degrees F.) produced by the burning propellants is passed through test nozzles. Basic measurements are made to establish heat transfer between the hot gas and the nozzle wall. Soon this work will be extended to cover the transfer of heat from the nozzle wall to the liquid hydrogen used to cool the nozzle. This heat transfer research is being done to support development of a nozzle for nuclear rocket engines.

J-2 is also a hot firing rocket stand. Recently propellant system dynamic studies have been completed for liquid fluorine--liquid hydrogen and liquid oxygen--liquid hydrogen rocket engines. The facility presently is being rebuilt to support development of a gas generator for the M-I engine--a much larger version of the engines that will power the Centaur rocket.

J-3 and J-4 are designed for advanced tank tests with liquid hydrogen fuel. The storage of such a fuel on a space flight is a great problem because it must be kept within a relatively narrow temperature range. It, thus, must be shielded from the heat of the engines and the widely-varying temperatures encountered on a deep space flight.

J-5, a large steel globe left over from Plum Brook's Army days, has been converted into a hydraulics laboratory for liquid fluorine tests. The globe assures that any accidents with the high-toxic and inflammable fluorine will be contained. A porthole is provided for long-range television viewing of experiments.

Heading the Rocket Systems Research Facility as Division Chief is Glen Hennings. Hennings has been associated with the Lewis Research Center since 1944 and has specialized in the research fields of chemical rockets and high-energy propellants, particularly hydrogen and fluorine.

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AEC

UNITED STATES
ATOMIC ENERGY COMMISSION
WASHINGTON, D.C. 20545

X Lewis RC ?

No. G-46
Tel. 973-3335 or
973-3446

FOR IMMEDIATE RELEASE
(Monday, March 2, 1964)

Plum Brook

ADVISORY COMMITTEE ON REACTOR SAFEGUARDS REPORTS TO AEC ON TWO PROJECTS

The Atomic Energy Commission has received reports from its Advisory Committee on Reactor Safeguards concerning two projects. They are the nuclear power plant proposed by Connecticut Yankee Atomic Power Company at Haddam, Connecticut, and the National Aeronautics and Space Administration research and testing reactor now operating at NASA's Plum Brook facility near Sandusky, Ohio.

Connecticut Yankee Atomic Power Company, composed of 12 New England utility companies, has applied to the Commission for a permit to construct a 490,000 gross electrical kilowatt nuclear power plant at Haddam Neck, on the east bank of the Connecticut River. This site is about 21 miles southeast of Hartford and 25 miles northeast of New Haven. The plant would be powered by a pressurized water reactor. The Commission has scheduled a public hearing April 1 in Middletown, Connecticut, to consider the application for a construction permit. Further details on the hearing are in AEC public announcement G-47 which is being distributed today.

NASA is operating its 60,000 thermal kilowatt research and testing reactor at the Ohio facility under a provisional operating license issued by AEC on March 14, 1961. NASA has applied to the Commission for a full term license which would expire 10 years from the date of issuance.

The Advisory Committee on Reactor Safeguards is a statutory committee which advises the AEC on the safety aspects of nuclear reactor design and operation. The ACRS was requested to review the applications of Connecticut Yankee and NASA. Copies of its reports are attached. The AEC regulatory staff is continuing its review of the two applications.

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3/2/64

ATTACHMENT #1

ADVISORY COMMITTEE ON REACTOR SAFEGUARDS
UNITED STATES ATOMIC ENERGY COMMISSION
Washington 25, D.C.

February 19, 1964

Honorable Glenn T. Seaborg
Chairman
U. S. Atomic Energy Commission
Washington, D. C.

Subject: REPORT ON CONNECTICUT-YANKEE ATOMIC POWER COMPANY

Dear Dr. Seaborg:

At its fifty-third meeting, February 13-15, 1964, the Advisory Committee on Reactor Safeguards reviewed the general design of the proposed 1473 MW(t) pressurized water reactor to be constructed at the Haddam, Connecticut site. The Committee had the benefit of a subcommittee meeting on December 13, 1963 with the applicant and its contractors. In addition, the documents referenced below were provided the Committee. The Committee had discussions with the applicant and representatives of Westinghouse Electric Corporation, Stone and Webster Corporation, and with the Regulatory Staff and its consultant from the U. S. Geological Survey.

In its previous report to the Commission on February 6, 1963, the ACRS pointed out that the Haddam Site did not meet the present site distance criteria, and hence reliance must be placed upon engineered safeguards to reduce off-site exposures in the unlikely event of a serious accident. Because of otherwise favorable site location, low population density and meteorological characteristics, a reduction factor of about 6 in addition to that provided by containment is needed to bring the potential dose from a maximum hypothetical accident to guideline limits.

The proposed design has the reinforced concrete containment described below. The design includes the following additional engineered safeguards: an internal recirculation containment spray system; a continuously operated air recirculation system with cooling, involving four independent units; and a

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filtration-adsorption unit on each of the recirculating systems which can remove halogens and other fission products. The plant is also to be provided with a safety injection system having three independent pumps and a large supply of borated water.

A reinforced concrete containment vessel with a steel inner liner is proposed. Containment leakage is specified to be not more than 0.1% per day and penetration leakage rates will be monitored. The proposed containment is designed for the use of stainless steel clad fuel elements in the reactor. If, for instance, Zircaloy cladding is used, it may be necessary to increase the design pressure or volume of the containment.

The reactor is to be a pressurized water system of proven operating characteristics with cluster type control rods. The use of four separate steam generator loops decreases the significance of a major primary coolant line rupture. Details of the reactor physics behavior will be resolved during the design phase. The Committee believes the possibility and effects of control rod ejection deserve further evaluation and documentation.

The Committee considers that the proposed engineered safeguards provide the necessary redundancy and reliance to assure reduction of releases to below guideline values in the unlikely event of a reactor accident. The filter-adsorber systems, while not finally selected as to performance characteristics, should be protected against steam and water releases, and may require capability for various forms of halogens. These factors should be reliably established before the facility operates.

It is the opinion of the ACRS that the proposed engineered safeguards, including the containment as proposed, will provide the necessary protection in the unlikely event of an accident. On this basis, the ACRS believes that there is reasonable assurance that the general type of reactor proposed for the Connecticut Yankee Atomic Power Company, including engineered safeguards, can be constructed at the Haddam Site with reasonable assurance that it can be operated without undue hazard to the health and safety of the public.

(more)

Dr. T. J. Thompson did not participate in this review.

Sincerely yours,

/s/ Herbert Kouts

Herbert Kouts
Chairman

References:

1. "Connecticut Yankee Atomic Power Company Nuclear Power Plant - Unit No. One - Haddam, Connecticut - Preliminary Hazards Summary Report", dated September, 1963.
2. Amendment No. 1 to License Application, dated September 25, 1963.
3. Amendment No. 2 to License Application, dated January 15, 1964.
4. Amendment No. 3 to License Application, dated January 20, 1964.

ATTACHMENT #2

ADVISORY COMMITTEE ON REACTOR SAFEGUARDS
UNITED STATES ATOMIC ENERGY COMMISSION
Washington 25, D.C.

February 19, 1964

Honorable Glenn T. Seaborg
Chairman
U. S. Atomic Energy Commission
Washington, D. C.

Subject: REPORT ON NASA PLUM BROOK REACTOR FACILITY

Dear Dr. Seaborg:

At its fifty-third meeting on February 13-15, 1964, the Advisory Committee on Reactor Safeguards again considered operation of the 60 MW(t) test reactor at the NASA Plum Brook station near Sandusky, Ohio. The NASA wishes to convert its present provisional operating license to a ten-year operating license. The Committee heard oral presentations by the PBRF organization and the AEC staff, and had the reports cited below. The Committee last commented on the PBRF on April 4, 1962.

The facility has operated up to full power since April 21, 1963, and has carried out a number of irradiation tests. During the operation, a number of facility modifications have been made, and minor operating problems have been corrected. No major design or operating problems have been reported.

At PBRF, reviews of the design of experiments and of the associated operation are conducted by the facility Safeguards Committee which is made up of eigh members: four from PBRF, two from Lewis Research Center, and two consultants who are not regular NASA employees. Ad hoc members are added as needed. The ACRS believes that a careful review of experiments and operations by the full facility Safeguards Committee is an important continuing function and that non-NASA members are necessary to a balanced observation and independent Committee action.

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In its letter of November 5, 1957, the Committee noted that, due to site limitations, it might be unsafe to carry out some tests in this facility.

The Committee believes that, with careful planning and operation, the NASA PBRF organization can continue to operate this facility without undue hazard to the health and safety of the public.

Sincerely yours,

/s/ Herbert Kouts

Herbert Kouts
Chairman

References:

1. Letter from S. Neil Hosenball, NASA Lewis Research Center, to AEC Director, Division of Licensing and Regulation, dated January 10, 1964.
2. "Report on Approach to Power Test Program and Other Operations Pertinent to Safety for the NASA Plum Brook Reactor", dated May 27, 1963.
3. "Report of Reactor Operations for the NASA Plum Brook Reactor", dated November 18, 1963.

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PHONE - (AREA CODE 216) 252-7700 EXT. 415

FOR RELEASE: IMMEDIATE

Release 64-7

(Hugh W. Harris: 252-7700, ext. 415)
res: 681-9354

CLEVELAND, Ohio, Jan. 24--An $830,903 contract for two advanced pressurization systems for cryogenic propellants has been awarded to the Martin Company by the National Aeronautics and Space Administration's Lewis Research Center.

The systems will be tested at Lewis to determine possible application to future manned and unmanned spacecraft and include multiple re-start capabilities in a zero gravity environment. It could be used on spacecraft for changing course, soft landing on another planet, or returning to earth.

The system will be used with pressure-fed liquid hydrogen-liquid oxygen rocket engines, and is the first such system to be designed specifically for spacecraft usage. The tank pressure is used to feed the propellants directly to the engine, eliminating the need for turbo pumps.

The primary system will use helium stored at liquid hydrogen temperatures to maintain a constant pressure in the hydrogen fuel tank and LOX oxidizer tank. The advanced version will require design and development of a system requiring an extension of present technology.

Both systems must be storable in space up to 20 days and provide a throttling method to control engine thrust.

Work on the project will be performed at the Martin Company's Denver Division.

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FOR RELEASE: IMMEDIATE

Release 64-8

(Hugh W. Harris: 252-7700, ext. 415)
res: 681-9354

CLEVELAND, Ohio, Jan. 24--Three inventions to increase the usefulness of NASA's large nuclear research reactor at the Lewis Research Center's Plum Brook Station won incentive awards for their inventors today. A fourth award went to a Lewis inventor who devised a better logic circuit to handle data accumulated by satellites and transmit it back to earth.

Seven hundred dollars went to Robert Steinberg of 748 Carteret Court, Berea and William B. Schwab of 4545 West 105th Street, Cleveland. Steinberg and Schwab developed a method and device for mapping the neutron flux or power level of each section of a reactor in a fraction of the time necessary by previous methods.

John W. Macomber of 30208 Crestview Drive, Bay Village, was awarded $500 for his invention of a nuclear reactor control rod assembly with improved driving mechanism. This assembly is used for controlling the power level in a reactor.

A $200 award was presented to Joseph M. Savino of 723 Wesley Drive, Berea, and Chester D. Lanzo of 22095 Cottonwood Drive, Rocky River, for developing a simulated fuel assembly for the reactor. The

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simulated fuel assembly is substituted for the actual fuel rods in the reactor and is instrumented to measure the flow of cooling water through the reactor. A nuclear reactor cannot be operated satisfactorily unless the coolant flow through each part of its core is adequate.

The transistorized logic circuit developed by John C. Sturman of 4336 Grannis Road, Fairview Park, won a $100 award. Used for relaying information back from satellites and space probes, his circuit offers increased efficiency and decreased power consumption.

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FOR RELEASE: IMMEDIATE

Release 64-12

(Hugh Harris: 252-7700, ext. 415)
res: 681-9354

CLEVELAND, Ohio, Feb. 12--A request for bids has been issued for the initial construction phase of a 500 foot drop tower for producing zero gravity environments by the National Aeronautics and Space Administration's Lewis Research Center.

The drop tower, which will be the largest zero gravity facility in the United States, will be able to provide weightlessness for periods up to 10 seconds. Actual free fall distance of the tower will be 400 feet.

Up to five seconds of zero gravity time will be produced by dropping experiments from the top of the tower. Longer periods will be obtained by shooting the experiment up from the bottom by means of a gas charged piston device developed by Lewis scientists. It will be capable of boosting a 6,000-pound experiment to the top of the tower. Foamed plastic will be used to decelerate the experiments.

A vacuum system will allow the air pressure in the shaft to be reduced to that found at an altitude of about 50 miles. This eliminates the need to surround an experiment with the drag shields used in conventional drop towers.

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The first step in the program is construction of a concrete lined shaft 520 feet deep and 28 feet in diameter. A 48 foot high service building will be built on top of the shaft to contain the vacuum pumps, model preparation area and a crane for handling the models. A one story addition to the side of the service building will contain a control room, mechanical services room, field office, and clean room for preparing the liquid containers to be used on the models.

The new facility will be used in investigating the behavior of liquid and vapor systems during weightlessness. This includes the positioning of liquids in propellant tanks, and condensers and evaporators of auxiliary power systems. This behavior affects engine restarting, tank venting, propellant transfer in space and proper operation of power generating systems. One or more of these problems occur in the Apollo vehicle, SNAP-8 (System for Nuclear Auxiliary Power), the Centaur vehicle and any other vehicle or spacecraft required to coast during part of its mission.

At present, Lewis scientists are working with a 100 foot drop tower providing two to four seconds of zero gravity time for models up to 10 inches in diameter. It is important to increase model size to test the effects of scaling up designs over as wide a range as possible, thus allowing better design of full-sized vehicles. Models up to four feet in diameter will be used in the new facility.

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FOR RELEASE: IMMEDIATE

Release 64-13

(Hugh W. Harris : 252-7700, ext. 415)
res : 681-9354

CLEVELAND, Ohio, Feb. 19--More than $14.5 million in major contracts were awarded during January by the National Aeronautics and Space Administration's Lewis Research Center here in support of its space research and development programs.

Contracts of $25,000 or more went to companies in eight states. They are listed alphabetically by state and city.

CALIFORNIA:	$11,476,854
Los Angeles	USAF Systems Command, $320,000, modifications to a SLV-III dock to convert it to a Centaur booster configuration. USAF Systems Command, $300,000, continued funding of studies to produce guidance equations for Agena vehicles.
Malibu	Hughes Aircraft Co., $98,984, research on problems of ion beam formation from electron bombardment ion sources. Hughes Aircraft Co., $30,000, continued funding of ion engine development program.
Oakland	Fisher Governor Co., $30,016, ball valves.

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Sacramento	Aerojet-General Corp., $2,110,000, continued funding of M-I, 1.5 million pound thrust liquid hydrogen-liquid oxygen engine program.
San Diego	General Dynamics/Astronautics, $1,800,000, OAO shroud system and Point Loma test program. General Dynamics/Astronautics, $99,208, theoretical and experimental research program to study the effect of high pressure on the conductivity of vapors. General Dynamics/Astronautics, $38,340, storage, preservation, maintenance and inspection of 3 Mercury type Atlas boosters. General Dynamics/Astronautics, $3,117,587, continuing development of Centaur.
Stanford	Stanford University, $99,358, continuation of a study of space propulsion systems.
Sunnyvale	Lockheed Aircraft Corp., $3,433,361, funding for Agena B vehicles.
FLORIDA:	$29,671
Coral Gables	Wackenhut Services Co., $29,671, guard services for Lewis Research Center during November, December and January.
INDIANA:	$131,203
South Bend	Bendix Corp., $131,203, fabrication and test of pneumatic control actuator assemblies.
MASSACHUSETTS:	$498,574
Cambridge	Arthur D. Little, Inc., $322,185, basic investigation of multilayer insulation systems. Controls for Radiation, Inc., $90,562, radiation protection services at Plum Brook Station.
Waltham	Parametrica, Inc., $48,225, development of a high temperature sensor device to measure temperature in a nuclear rocket engine. Thermo Electron Engineering Co., $37,602, three variable parameter research thermionic diodes.

NEW JERSEY:	$193,008
Harrison	Radio Corp. of America, $96,268, program of development and testing in conjunction with Lewis to determine the high magnetic field superconducting properties of Nb_3Sn films on insulator and magnetic substrates. Radio Corp. of America, $96,740, program of development and testing to establish the feasibility of building a 150 kilogauss, large volume superconducting magnet with vapor deposited Nb_3Sn tape.
OHIO:	$2,034,704
Cincinnati	Astro-Met Associates, $54,901, development of a large size porous tungsten ionizer. General Electric, $874,363, continued research and development of two stage potassium turbine. General Electric, $29,480, contamination studies.
Cleveland	Worthington Corp., $49,540, service,labor and material to convert an ammonia compressor to non-contaminating argon service. Titanium Metals Corp., $32,062, titanium alloy. Electric Illuminating Co., $804,458, electric services for Lewis from July through December 1963.
Mansfield	R. G. Beer Corp., $189,900, construction of a utilities area for the space propulsion facility at Plum Brook Station.
PENNSYLVANIA:	$216,071
Middletown	USAF Logistics Command, $48,666, bulk liquid hydrogen for last six months of FY'64.
Philadelphia	High Temperature Instrument Corp., $51,921, development of techniques and location of thermocouples in nuclear rocket engines.
Pittsburgh	Westinghouse Electric/Astro Nuclear Laboratory, $115,484, research for determining the weldability and high temperature stability of refractory metals.

TEXAS:	$101,693
Forth Worth	General Dynamics, $101,693, funding for pyrotechnic shroud separation system for Mariner C mission.

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FOR RELEASE: IMMEDIATE

Release 64-14

(Henry Jacques: 252-7700, ext. 415)
res: 251-1047

SANDUSKY, Ohio, Feb. 25--The first shipment of spent reactor fuel elements left the National Aeronautics and Space Administration's Plum Brook Station here recently.

A specially-rigged truck carried the cargo of 28 fuel elements from the complex housing the 60,000-kilowatt nuclear research reactor, which achieved operational status last July. The National Lead Corporation is handling used fuel transports for the facility under a NASA contract.

The fuel elements were taken to the Idaho Chemical Processing Plant, operated by Phillips Petroleum Co. for the National Reactor Testing Station in Idaho, for re-processing. The trip, all by truck, took three days.

The elements had been held in one of the reactor's hot storage areas, under 23 feet of water shielding, for many months. They had been removed from the reactor core during an early cycle shutdown.

The "end boxes" or handling devices were cut from the fuel elements with an underwater saw in preparation for transport. As shipped, the elements were each three inches square by 25 inches long.

- more -

The rods were taken from underwater storage racks with grappling devices and placed in a cask. Instruments were used to monitor the radioactivity of the elements during the underwater transfer.

The cask, which weighs 22,000 pounds and has nine-inch-thick lead walls, was placed in a special mount on the truck trailer and secured with cables. A 3,000-pound shield was positioned over the cask to protect it in case of fire during the trip.

Two drivers were assigned to the truck for the trip to Idaho. The vehicle is never left unattended.

Shipment of irradiated material is under the control of the Atomic Energy Commission. The transporting company and NASA must be licensed by the AEC for the fuel shipment.

The Plum Brook Reactor is being used in basic research experiments associated with NASA's plans to develop a nuclear rocket, and the development of components and systems for space nuclear auxiliary and main propulsive power.

Work at the facility is under direction of the Lewis Research Center, Cleveland, of which the Plum Brook Station is a part.

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News

NASA LEWIS RESEARCH center

21000 BROOKPARK ROAD CLEVELAND, OHIO 44135

PUBLIC INFORMATION OFFICE
PHONE - (AREA CODE 216) 252-7700 EXT. 415

FOR RELEASE: IMMEDIATE

Release 64-15

(Hugh W. Harris: 252-7700, ext. 415)
res: 681-9354

CLEVELAND, Ohio, Feb. 24--A $52,700 contract for design and fabrication of a self-propelled underwater truck has been awarded by the National Aeronautics and Space Administration's Lewis Research Center to Aerojet-General Nucleonics, San Ramon, California.

The contract calls for the design and construction of an underwater carrier capable of transporting up to 6,000 pounds to and from the 60,000 KW nuclear research reactor at Lewis' Plum Brook Station near Sandusky.

The Plum Brook Reactor is one of the largest of its kind in the country. It is surrounded by quadrants of water approximately 30 feet across and 25 feet deep which are used as biological shielding. A series of canals lead from the shielding quadrants to the hot labs and experiment preparation rooms.

Called an "Underwater Universal Dolly" by its builder, the device will carry a cylindrical container eight and a half feet in diameter by ten and a half feet tall with a snout 13 feet long and 12 inches in diameter. The experiment will ride in the snout with its supporting equipment and instrumentation in the larger vessel.

The dolly is powered by a hydraulic pump system which uses the water in the canals to propel it. It will run on wheels but be guided by a track. Except for maintenance and repairs, it will remain in the water.

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FOR RELEASE: IMMEDIATE

Release 64-20

(Hugh W. Harris: 433-4000, ext. 415)
res: 681-9354

CLEVELAND, Ohio, Mar. 17--More than $2.9 million in major contracts were awarded during February by the National Aeronautics and Space Administration's Lewis Research Center here in support of its space research and development programs.

Contracts of $25,000 or more went to companies in four states and the District of Columbia. They are listed alphabetically by state and city.

ALABAMA:	$33,000
Huntsville	Space Craft Inc., $33,000, design, construction and test of 12 current monitors.
CALIFORNIA:	$1,803,684
Canoga Park	North American Aviation, $333,579, additional FLOX compatibility studies on booster gas generator and vernier engine for Atlas launch vehicle.
Malibu	Hughes Aircraft Co., $1,145,258, follow-on program of ion rocket engine development.
Pasadena	Electro Optical Systems, Inc., $47,995, analytical and experimental studies of surface ionization.
Redondo Beach	Space Technology Laboratories, Inc., $77,974, launch wind constraints study for Atlas-Centaur vehicles.

- more -

CALIFORNIA (Cont.)

San Bernardino	USAF Systems Command, $80,710, transportation charges for equipment being transferred from AF Thor program.
San Diego	General Dynamics/General Atomic, $118,168, facilities for program on use of carbides for cathodes in thermionic converters.

DISTRICT OF COLUMBIA: $279,500

Washington	U.S. Atomic Energy Commission, $183,500, development and construction of dynamic pressure measuring systems for closed cycle liquid metal facilities. U.S. Atomic Energy Commission, $96,000, arrangements for in-pile casule irradiation and hot cell examinations of tungsten UO_2 specimens.

ILLINOIS: $143,851

Evanston	Linear, Inc., $148,851, development, fabrication and evaluation of modular type solar simulator.

OHIO: $679,686

Cleveland	Clevite Corp., $99,853, study of thin film, large area photovoltaic solar energy converter. R. Hansen Co., $37,924, construction of an addition to the Liquid Metals Power Laboratory. George S. Rider Co., $60,000, modernization of Instrument Research Laboratory.
Fremont	Mosser Construction, Inc., $144,000, addition to central control building for Rocket Systems Research Facility at Plum Brook Station.

- more -

OHIO (Cont.)

Lorain	T. J. Hume Co., $246,500, construction of office building at the reactor complex at Plum Brook Station.
Huron	Wilkes and Company, Inc., $31,465, addition to Waste Handling Building.
Willowick	Cleveland Tool and Die Co., $59,944, casule assembly.

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PHONE - (AREA CODE 216) 433-4000 EXT. 415

FOR RELEASE: IMMEDIATE

Release 64-21

(Hugh W. Harris: 433-4000, ext. 415)
res: 681-9354

CLEVELAND, Ohio, Mar. --A $900,000 authorization to do research and development work in connection with advanced nuclear rocket engines was granted today by the National Aeronautics and Space Administration's Lewis Research Center to the Atomic Energy Commission's Hanford Atomic Products Operation in Richland, Wash.

This agreement brings the value of work now being performed at Hanford for NASA to over 1.5 million dollars. The new work involves the fabrication, test and evaluation of tungsten uranium oxide fuel elements for an advanced nuclear rocket engine now under study at Lewis.

Work under the first agreement began at Hanford in May of last year and called for the fabrication and test of various fuel element configurations at high temperatures.

NASA's agreements with the Hanford Operation is the result of the AEC's efforts to make available its capabilities and facilities to other government agencies whenever feasible.

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FOR RELEASE: IMMEDIATE

Release 64-23

(Hugh W. Harris: 433-4000, ext. 415)
res: 681-9354

CLEVELAND, Ohio, Mar. 17 -- The opportunity to work on space research projects at the National Aeronautics and Space Administration's Lewis Research Center here is being offered to college instructors and professors through a unique new summer program.

Called the NASA Summer Faculty Fellowship Program, it will give college instructors and professors in engineering and the physical sciences a chance to work on significant space research projects and attend a special graduate level course in chemical rocket technology at the Case Institute of Technology. Course work, library study, and time for faculty consultation should take about 10 hours a week.

Dr. Walter T. Olson, assistant director at Lewis, said, "The program is expected to have widespread benefits. The educators who participate will be given a chance to expand their professional knowledge and carry this experience back to their institutions and students. It will be immediately reflected in the level of research work done at the university. Ultimately, it will benefit industry and government agencies who employ the students."

Applicants for the program should be instructional or research staff members with two or more years of experience. Fellowship

(more)

stipends have been established to meet the regular salary of the participants. Travel expenses will also be paid.

Fellows will be selected by Lewis and Case with consideration to interest, potential value to the participant's institution, and competence in available research areas.

At Lewis, the summer fellows will do research in a number of areas, including: fluid mechanics, heat transfer, materials and metallurgy, nuclear studies, electric propulsion and direct energy conversion.

Subjects to be covered in the course of instruction at Case are: missions and requirement, handling of liquid fuels, thermodynamics of high temperature gases, rocket motor flows, combustion and dynamics and control of the propulsion system.

It is hoped that participants will make a two-summer commitment in order to acquire a reasonable background and make a significant research contribution. The course of study during the second summer will include selected topics such as nuclear rocket technology, plasma physics and electric propulsion.

Applications for the Lewis-Case program may be obtained from Dr. Isaac Greber, Associate Professor of Aeronautical Engineering, Case Institute of Technology, 10900 Euclid Ave., Cleveland, Ohio. Applications must be in by April 1. The summer program will start June 15 and run to August 21.

Two other NASA research centers and universities are also participating in the program. In California, Ames Research Center and Stanford University are cooperating. In Virginia, Langley Research Center and the University of Virginia are conducting the joint program.

The American Society for Engineering Education is cooperating with NASA in establishing the program.

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FOR RELEASE: IMMEDIATE

Release 64-25

(Lynn Manley: 433-4000, ext. 415)
res: 243-3489

CLEVELAND, Ohio, Mar. 24--Space-age exhibits will join science, industry and historical displays this Saturday (March 28) to share the spotlight at the private dedication of the Center of Science and Industry in Columbus.

In cooperation with the new center - designed as a museum of science, industry, health, and history - the National Aeronautics and Space Administration and NASA's Lewis Research Center here are sponsoring a comprehensive exhibit of the nation's space program.

Dignitaries, including Gov. James A. Rhodes, will help dedicate the center. Eugene J. Manganiello, deputy director of the Lewis Research Center, will represent NASA.

The new center, located in downtown Columbus in a building formerly known as Memorial Hall, will be open to the public beginning Sunday, March 29 at 2 p. m. It is a non-profit organization dedicated to the understanding of science, industry, health, and history.

NASA exhibits will be located in two separate areas. A first floor stage display represents the nation's man-in-space program and will include a full-scale Mercury spacecraft with its escape tower. A large world globe, center-stage, is encircled by multi-colored rings depicting the many satellites and spacecraft in orbit about the earth.

- more -

A 21-foot tall high-energy research rocket also will be included, with a separate model showing its tanks, pumps and engines.

In the second floor exhibit will be a giant mosaic-type mural of NASA's Lewis Research Center. Exhibits and displays in this area will describe and illustrate NASA's past and future space programs... Gemini, Apollo, space sciences, communications and weather satellites, and various propulsion systems.

In the lobby of the center, dominated by a Foucault Pendulum which illustrates the earth's rotation, will be a one-third scale model of the Mercury spacecraft and a simulated spacesuit worn by U. S. astronauts.

Among exhibits installed by NASA at the center is a model of a full-scale Mercury spacecraft. All NASA items will be available for public viewing for at least three months.

In addition to the space exhibits, the center will have a "Street of Yesteryear," depicting periods from 1840 to 1910; a planetarium with a 30-foot dome on which galaxies can be projected; a transparent "talking woman," housed in plexiglass, who "describes" her organ functions via audio transmission; and many other scientific, industrial and historical exhibits.

The Science Center is also planning a broad educational program for students and adults. A modern auditorium, completely equipped with sound motion picture equipment, slide projector, public address system and recording equipment, will be used in conjunction with the educational program.

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PHONE - (AREA CODE 216) 433-4000 EXT. 415

FOR RELEASE: IMMEDIATE

Release 64-28

(Joann Temple : 433-4000, ext. 415)
res : 941-4769

CLEVELAND, Ohio, April 1--Sputtering is one of several techniques being tried to produce flexible, thin-film solar cells at the National Aeronautics and Space Administration's Lewis Research Center.

Conventional solar cells like those used on the Telstar satellite are slices of large crystals of silicon. These cells are heavier than desired and require rigid panels for support. The panels must be folded during launch and then unfolded in space. Such packaging causes serious problems in designing large solar panels.

Scientists at Lewis are using sputtering to research thin-film cells which may solve the problem of both weight and flexibility. Such thin-films have been made by evaporating a photovoltaic semiconductor material onto a metal foil in a high vacuum. However, this established evaporation process does not work with all semiconductors.

For example, the semiconductor gallium arsenide will split into gallium and arsenic when it is vaporized. However, when particles of gallium arsenide are sputtered off an electrode by high voltages instead of vaporized by heat, they will deposit intact on the film surface.

Sputtering must be done in an absolutely clean atmosphere because any oil or impurities in the air could deposit on the film. It also requires a low pressure of inert gas, usually argon. The pressure, temperature and voltage must all be rigidly controlled in relation to each other.

- more -

This is an elaborate control problem, especially considering that gas is flowing into the chamber and being continuously pumped out all the time.

A sputtering apparatus in which the controls are fully automated has been built at Lewis under the direction of John C. Evans, Jr. With this equipment, research is underway on reducing the weight and improving the efficiency of thin-film solar cells. Present evaporated thin-film cells convert only about 3% of the available solar energy into electricity.

It is hoped that this efficiency can be increased to approach the 15% mark of the best silicon cells.

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PHONE - (AREA CODE 216) 433-4000 EXT. 415

FOR RELEASE: IMMEDIATE

Release 64-30

(Hugh W. Harris: 433-4000, ext. 415)
res: 681-9354

CLEVELAND, Ohio, Mar. 27--A $797,200 contract for construction of the concrete-lined shaft for the 500-foot zero gravity facility has been awarded by the National Aeronautics and Space Administration's Lewis Research Center to Patrick Harrison, Inc., Golden, Colo.

Construction of the 500-foot underground shaft is the first phase of the project which will result in the largest zero gravity facility in the United States. Actual free fall distance of the tower will be 400 feet. The shaft should be completed by the end of this year. Included in the contract is construction of the foundation for the facility's service building.

Up to five seconds of zero gravity time will be produced by dropping experiments from the top of the tower. Ten seconds of weightlessness can be produced by shooting the experiment up from the bottom by means of a gas-charged device developed at Lewis. The device will be capable of boosting a 6,000-pound experiment to the top. Foamed plastic will be used to decelerate experiments.

One of the unique features of the facility will be its vacuum system to reduce air pressure to that found at an altitude of about 50 miles. This eliminates the necessity of enclosing experiments in drag shields necessary in other facilities.

In addition to the longer zero gravity time available in the new facility, experiments much larger than ever before can be conducted. Work will be concentrated on complete systems rather than small components.

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FOR RELEASE: IMMEDIATE

Release 64-37

(Hugh W. Harris: 433-4000, ext. 415)
res: 681-9354

CLEVELAND, Ohio, April 15 -- More than $3.5 million in major contracts were awarded during March by the National Aeronautics and Space Administration's Lewis Research Center here in support of its space research and development programs.

Contracts of $25,000 or more went to companies in seven states and the District of Columbia. They are listed alphabetically by state and city.

CALIFORNIA:	$1,488,155
Anaheim	Astrodata, Inc., $93,735, central timing system, tape search systems and remote timing systems.
Concord	Systron Donner Corp., $26,939, rate transducers.

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CALIFORNIA (Cont.)	
Malibu	Hughes Aircraft Co., $479,024, development of ion engine system for SERT I. Hughes Aircraft Co., $95,747, fabrication and testing of power conditioner systems. Hughes Aircraft Co., $49,980, program of research and study on electrode surface physics.
Pasadena	Electro-Optical Systems, Inc., $123,350, development of composite ionizer materials. Electro-Optical Systems, Inc., $493,081, design, development, fabrication and testing of a cesium electron bombardment ion engine system.
Redondo Beach	Thompson Ramo Wooldridge, Inc., $97,200, program of analytical and experimental study of porous metal ionizers.
San Diego	General Dynamics/General Atomic, $29,099, measurement of neutron spectra in liquid hydrogen.
COLORADO:	$797,200
Golden	Patrick Harrison, Inc., $797,200, services, materials and labor to construct concrete lined shaft and service building foundations for the zero "g" facility.
CONNECTICUT:	$59,700
Greenwich	Kurt Orban Co., Inc., $59,700, dynamic balance machine.

- more -

DISTRICT OF COLUMBIA:	$235,000
Washington	U. S. Atomic Energy Commission, $110,000, materials for advanced reactors. U. S. Atomic Energy Commission, $75,000 non-destructive test development for high temperature nuclear components. U. S. Atomic Energy Commission, $50,000, tungsten-uranium dioxide reactor fuel elements feasibility study.
FLORIDA:	$254,382
Ft. Lauderdale	Systems Engineers Lab., Inc., $254,382, four hundred and two hundred channel facility sub-systems.
MARYLAND:	$145,175
Cockeysville	Aircraft Armaments, Inc., $145,175, payload housing for a WASP fluid dynamic experiment.
NEW JERSEY:	$266,400
Paterson	Boque Electric Mfg. Co., $136,900, furnish and install one 200 kilowatt variable frequency power supply to provide three phase power over a frequency range of 200 to 2,000 cps from a source of 2400 volts.
Princeton	R. C. A. Laboratories, $129,500, program for the development of thin film solar cells.
OHIO:	$261,597
Cleveland	Damon-Worley, $67,000, design, specifications and cost estimate for engineering building at Plum Brook Station.

- more -

Columbus	Battelle Memorial Institute, $62,645, development of high temperature sensor to measure temperature in a nuclear rocket.
Lorain	Wilkes and Company, Inc., $28,500, services, labor, material and equipment to repair, rebuild and clean the Rye Beach raw water intake line for Plum Brook Station. Lake Erie Electric Co., $69,350, services, labor and materials for furnishing, installing and connecting an electrical control system in the Nuclear Rocket and Dynamics Control Facility at Plum Brook Station.
Mansfield	R. G. Beer, Corp., $34,102, services, labor and materials to construct an addition to the B-1 Boiler House at Plum Brook.

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PHONE - (AREA CODE 216) 433-4000 EXT. 415

FOR RELEASE: IMMEDIATE

Release 64-38

(Henry T. Jacques: 433-4000, ext. 415)
res: 251-1047

CLEVELAND, Ohio, April 17--Inventions in areas ranging from electric propulsion to magnetic fuels to a black-body furnace won awards this week for seven researchers at the National Aeronautics and Space Administration's Lewis Research Center.

The four inventions won a total of $1,400 in awards made under provisions of the Government Employees Incentive Awards Act.

S. Stephen Papell, a member of the Cryogenic Heat Transfer Section of Lewis' Chemistry and Energy Conversion Division, was awarded $500 for his invention of a low viscosity magnetic fluid obtained by the collodial suspension of magnetic particles.

Papell's invention deals with the problem of collecting fuel near the pumps for re-start of a rocket vehicle engine in weightlessness. This problem may be resolved through magnetic propellants. An electromagnet located near the pumps could attract the magnetic fuel and guarantee a fast re-start.

An electrostatic ion engine with a permanent magnetic circuit won a joint award of $500 for Paul D. Reader and Harold R. Kaufman, both of Lewis' Electromagnetic Propulsion Division.

The invention is a lightweight design for a permanent magnetic circuit. It avoids the need for power sources for the magnetic field,

- more -

but at the same time does not impose a weight penalty over a coil design.

Kaufman is head of the Advanced Systems Section. Reader heads the Electrostatic Thrustor Systems Section.

Robert J. Branstetter and Allen J. Metzler shared $300 for their invention of a black-body furnace. The high temperature furnace is being used primarily for pyrometer calibrations.

Both men work in the Direct Energy Conversion Branch, Chemistry and Energy Conversion Division.

John R. Jack, head of the Electrothermal Section, Electromagnetic Propulsion Division, and a member of that section, Paul F. Brinich, won a joint award of $100 for the invention of improved heat exchangers for electro-thermal rockets. The improved heat exchangers will be used in resisto jet thrustoers.

AVON:	
Robert J. Branstetter	3159 Jaycox Road
BEREA:	
Harold Kaufman	301 Craft Street
S. Stephen Papell	75 Meadow Drive
CLEVELAND:	
Allen J. Metzler	16846 Glenridge Avenue
LAKEWOOD:	
Paul Brinich	1456 Waterberry
NORTH OLMSTED:	
John R. Jack	5252 Hampton Drive
Paul D. Reader	5982 Forest Drive

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PUBLIC INFORMATION OFFICE
PHONE - (AREA CODE 216) 433-4000 EXT. 415

FOR RELEASE: WEDNESDAY P. M. 'S
April 29, 1964

Release 64-40

(Henry T. Jacques: 433-4000, ext. 415)
res: 251-1047

CLEVELAND, Ohio, April 29--A famous Cleveland landmark--the Terminal Tower on Public Square--will be the scene of a series of drop tests to be conducted by the National Aeronautics and Space Administration's Lewis Research Center.

Data obtained in the tests will aid Lewis engineers in the design of a decelerator for the Center's new zero-gravity facility. Now under construction, the facility will provide a free fall distance of 400 feet for the study of weightlessness effects on liquid and vapor systems.

In the Terminal Tower tests, some 20 drops from heights of up to 400 feet will be made in one of the main elevator shafts of the 52-story building. They will be conducted on two weekends--May 2 - 3 and May 16 - 17.

A 1/12th scale model of the experimental packages designed for the zero-gravity facility will be used in the tests. The steel model is 4 inches in diameter and 28 inches long, weighs 43 pounds.

An elevator stopped at various intervals up to the 32nd floor will provide the drop platform. The model will be hung by wire through a trap door in the bottom of the elevator. A small torch will cut the wire to start the drop.

- more -

The model will plunge into a deceleration tube at the bottom of the shaft. The tube measures one foot in diameter and 18 feet deep and is filled with cylinders of styrofoam.

Some 230 drop tests have been conducted by Lewis engineers in search of the proper material for use in the zero-gravity facility's decelerator cart. A series of styrofoam blocks appears to be the answer.

Data obtained in the Terminal Tower tests will be correlated with previous drop test results to check the styrofoam's capability for the deceleration task.

Most of the previous tests have been at Lewis' 85-foot drop tower. The highest drop made thus far was from a height of 150 feet in a test stand at the Center's Plum Brook Station in Sandusky, Ohio.

The need for a 400-foot height for obtaining data points on drops into styrofoam was answered when officials of the Terminal Tower Company agreed to allow Lewis engineers to use that building. Carl Schleuss is general manager of the firm, George Cowhard is operating manager.

Terrence E. Russel is the design engineer for Lewis and will head a crew of six for the Tower tests.

The new zero-gravity facility at Lewis will provide up to 10 seconds of weightlessness. The behavior of liquid and vapor systems during weightlessness will be investigated at the facility.

The position of liquids in propellant tanks and condensers and evaporators of auxiliary power systems in a weightless environment affects rocket engine restarting, tank venting, propellant transfer in space, and proper operation of power generation systems.

One or more of these problems occur in any vehicle required to coast in space during its mission.

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FOR RELEASE: MONDAY A. M. 'S
MAY 18, 1964

Release 64-42

X-Ref. Langley inspection, May 18-22 1964, complete)

A comprehensive propulsion exhibit representing work being done at the National Aeronautics and Space Administration's Lewis Research Center, Cleveland, Ohio, will be presented May 18 - 22 at the Langley Research Center during a detailed review of NASA's accomplishments in advanced research and technology.

The exhibit on OART work at Lewis covers four areas of propulsion--chemical, nuclear, electric and air-breathing.

One of the significant advances in air-breathing propulsion may well be for a supersonic transport aircraft. Military aircraft are flying faster than the speed of sound, but supersonic technology has yet to be adapted to a large commercial vehicle. The air-breathing exhibit explains a current concept of the powerplant for a supersonic transport. Such an engine would run hotter and more efficiently than the conventional turbo- or fan-jet engines now flying.

Lewis' work in chemical rockets extends from basic research on combustion instability to operational launches of Atlas and Thor-Agena vehicles and their various spacecraft. Development of the nation's first high-energy liquid hydrogen/liquid oxygen fueled rocket, Centaur, is also under Lewis direction.

- more -

A 1/20th scale model of the M-I engine is included in the chemical propulsion exhibit. This gigantic engine that consumes 100 tons of its high-energy propellants every minute is being developed by Lewis with future missions beyond the Moon in mind. But, because of the drawbacks of chemical propulsion for manned planetary missions, both nuclear and electric rockets are being researched and developed also.

When the time comes for deep space missions, there should be several means of propulsion available and they, like the current stable of conventional rockets, will no doubt perform differently for different missions.

The nuclear propulsion exhibit illustrates some of Lewis' current research in nuclear and materials technology and includes models of the NERVA (nuclear engine for rocket vehicle application) and a tungsten water-moderated reactor.

The electric propulsion exhibit features a conceptual design of a manned Mars spacecraft and an animated movie explaining how such a ship would take eight men on a 500-day round trip to Mars.

Research and development work in electric propulsion is represented and a model of a large ion engine is displayed. This model is typical of electrostatic engines now being studied at Lewis in a thrustor-scaling program designed to determine the upper limits of electrostatic engine size.

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FOR RELEASE: THURSDAY A. M. 'S
MAY 28, 1964

Release 64-43

(Joann T. Temple: 433-4000, ext. 415)
res: 941-4769

CLEVELAND, Ohio, May 28--What's out there in space and how do you bring it down to earth?

This is the subject of a Chicago Symposium on Aerospace Simulation today. The symposium, being held in conjunction with the annual American Society of Lubrication Engineers (ASLE) meeting, was chaired by Erwin V. Zaretsky, an engineer from the National Aeronautics and Space Administration's Lewis Research Center here.

Zaretsky pointed out that simulating space flight environment is not just a matter of low pressure and weightlessness. There are two kinds of space environment that must be considered. The first is the natural environment due to space itself. This includes such things as low pressure, low gravity, temperature variations, meteoroid impact, and solar radiation. Second there is the environment induced on a spacecraft because it is in flight in space. This "induced" environment includes shock, vibration, changes in motion and, in some cases, nuclear radiation.

The six symposium speakers discussed the problems of achieving these varied elements of space on the ground.

- more -

The design, fabrication and use of ultra-high vacuum chambers requires unique and reliable ways to measure low internal pressures. Duplicating the extremes of temperature in space also creates measurement and controls problems. Parts of a spacecraft move mechanically. Thus, mechanical motion must be possible in the ground space-simulator.

Lubricating moving systems in low pressures is yet another problem. Robert L. Johnson, Head, Lubrication Branch at Lewis, discussed two solutions to this lubrication problem---using conventional lubricants in a closed system and using stable metals or alloys that can serve as lubricants while exposed directly to the space environment.

This symposium was the first such all-inclusive meeting on the problems of defining, duplicating and measuring a simulated space environment.

Two other Lewis researchers contributed to the general ASLE meeting. Salvatore J. Grisaffe served as vice chairman of the Rolling Contact Bearing Session and James H. Dunn as vice chairman of the Fluid Film Bearings Session.

A native of Chicago, Zaretsky attended Illinois Institute of Technology, where he was graduated in 1957.

Johnson, a 1942 graduate of Montana State College, recently returned from Europe where he represented the United States at several OEDC (organization for economic cooperation and development) meetings.

Grisaffe, a native of La Grange, Ill., was graduated from the University of Illinois in 1957 and will receive his master's degree from Case Institute of Technology next year. Dunn attended Fenn College, graduating in 1952. Case Institute of Technology awarded him a master's degree in 1958.

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PHONE - (AREA CODE 216) 433-4000 EXT. 415

FOR RELEASE: IMMEDIATE

Release 64-44

(Joann T. Temple: 433-4000, ext. 415)
res: 941-4769

CLEVELAND, Ohio, May 20 -- Two technical staff members at the National Aeronautics and Space Administration's Lewis Research Center have recently applied for a patent on a portable electron-beam welder.

Although not quite a hand tool, the Lewis device allows previously impossible field repair or assembly. Electron beam welding had formerly dictated the use of a massive, stationary vacuum chamber. Lewis' new welder, vacuum chamber and all, weighs less than 50 pounds and measures about 21 inches by 21 inches. The necessary auxiliary vacuum pumping equipment and power supplies can be easily provided on carts or trucks.

Designer Richard A. Terselic describes the portable device as "a two section 'clamshell' design vacuum chamber with an electron beam welding unit mounted within, capable of rotating through a full 360°." The chamber and associated vacuum seals are designed to allow operation at pressures in the 10^{-6} torr range.

Terselic began working on the design when the co-inventor, Dr. Louis Rosenblum, Head, Liquid Metals Branch, came to him with a research problem. Rosenblum is concerned with refractory metals to be used in power generating plants for future spacecraft. Such spacecraft may well rely upon closed loop Rankine cycle systems using liquid metals as the working fluids. The components and piping for such systems must be made of the difficult-to-weld refractory metals.

- more -

Lewis' large electron-beam welding facility could handle all types of welds providing the workpieces could fit entirely within the facility. Rosenblum envisioned the time when large flow loops would be built which, in the final stages of assembly, could not be entirely located within a welding facility.

Terselic's demonstration prototype, portable electron beam welder has solved the problem in that the vacuum chamber and welder are assembled around the tubing joint to be welded. Even final closure welds in tubing loops can be made.

Two disposable vacuum seal inserts are mounted on either end of the tubing feed-throughs into the chamber. After the closure weld is made, the chamber and the welder can be opened and removed from the loop leaving only the two end seals behind. These two disposable seals can then be readily cut away.

In summing up, Terselic states that "this welder is constructed using common fabrication techniques from readily available vacuum quality materials, and is applicable to 'on site' or assembly floor use wherever electron beam welds may be required. Its size can be scaled up or down to handle the largest or smallest of welding jobs."

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FOR RELEASE: IMMEDIATE

Release 64-45

(Hugh W. Harris: 433-4000, ext. 415)
res: 681-9354

CLEVELAND, Ohio, May 26--More than $4.2 million in major contracts were awarded during April by the National Aeronautics and Space Administration's Lewis Research Center here in support of its space research and development programs.

Contracts of $25,000 or more went to companies in four states and the District of Columbia. They are listed alphabetically by state and city.

CALIFORNIA:	$269,627
Berkeley	University of California, $88,894, investigation of kilovolt ion sputtering.
Fullerton	Preston Scientific Co., $37,230, D.C. amplifiers and rack mounting modules.
Irvine	Dana Laboratories, $28,325, data logger
Malibu	Hughes Aircraft Co., $60,045, thrust stand system.
Palo Alto	Varian Associates, $55,133, ultra-high range vacuum system.

- more -

CONNECTICUT:	$86,244
Hartford	United Aircraft Corp., $86,244, development of inorganic ion exchange membrane.
DISTRICT OF COLUMBIA:	$995,480
Washington	U.S. Atomic Energy Commission, $100,000, tungsten fuel element of subassemblies. U.S. Atomic Energy Commission, $200,000, fabrication and operation of a "hot spot" loop. Atomic Energy Commission, $95,480, shielding for reactor hole. Atomic Energy Commission, $600,000, KIWI B-4 unfueled nuclear rocket reactor.
ILLINOIS:	$364,830
Chicago	Chicago Bridge and Iron, Inc., $364,830, 200,000 gallon liquid hydrogen storage dewar.
INDIANA:	$408,260
Indianapolis	F.M.C. Corp., $408,260, spray chamber circulation pumps.
MARYLAND:	$69,566
Laurel	Hydronautics, Inc., $69,566, study of behavior of materials under accelerated cavitation attack by liquid metals at high temperatures.
MASSACHUSETTS:	$935,595
Cambridge	Arthur D. Little, Inc., $114,770, development of improved coatings for glass monofilaments. Controls for Radiation, $686,500, radiation protection services for Plum Brook Station.
Everett	AVCO Corp., $134,325, study of magnetic annular plasma accelerator.

- more -

NEW HAMPSHIRE:	$100,000
Concord	Richard D. Brew Co., $100,000, six vacuum creep-rupture units.
NEW JERSEY:	$287,546
Long Branch	Electronic Associates, Inc., $218,650, analog computer system.
Princeton	Radio Corp. of America, $73,896, program in research on vapor filled thermionic converters.
NEW YORK:	$131,000
Buffalo	Bell Aerospace Corp., $95,000, accelerometer systems.
Farmingdale	Republic Aviation Corp., $36,000, impulse balance system.
OHIO:	$419,772
Akron	Goodyear Aerospace, $26,099, development and fabrication of embossed aluminum liners. Goodyear Aerospace, $33,364, development fabrication testing of Centaur tanks.
Cleveland	Carrier Corp., $40,495, three stage steam jet ejectors. Churchill Co., $26,394, cafeteria equipment for Development Engineering Building. H.K. Ferguson, Inc., $80,345, design specifications for the Electric Power Equipment Test Facility. Thompson Ramo Wooldridge, Inc., $113,493, investigation, testing and development of an electron bombardment ion engine system. Elmer Perkin Corp., $25,245, infrared spectrometer and accessories.
Columbus	Battelle Memorial Institute, $44,337, study of alpha cell direct conversion generator.

- more -

OHIO: (Continued)	
Toledo	Samborn, Steketee, Otis and Evans, $30,000, design, specification and cost estimates for experiment assembly test and storage building.
PENNSYLVANIA:	$133,284
Philadelphia	General Electric Co., $133,284, program to study and evaluate thermal integration of specified auxiliary power plants and life support sub-systems.
TEXAS:	$69,204
Dallas	Ling-Temco-Vought, Inc., $69,204, design, manufacture and test of a post-fourth-stage-burnout residual thrust-misalignment system for the NASA SERT - Scout vehicle.

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FOR RELEASE: IMMEDIATE

Release 64-46

(Joann T. Temple: 433-4000, ext. 415)
res: 941-4769

CLEVELAND, Ohio, May 26 -- The Fourth Annual Photovoltaic Specialist's Conference of the Institute of Electrical and Electronics Engineers, to be held June 2 and 3 at the National Aeronautics and Space Administration's Lewis Research Center here, will cover current technology, new knowledge and experimental research in the field of solar cells.

The first session will cover radiation effects extending from a specific discussion of radiation damage to solar cells on the Relay I and II satellites to radiation damage studies in the laboratory and a discussion of various means of protecting cells from such damage.

An entire session will be devoted to thin film solar cells including the recent development of cadmium sulfide cells. Ways to test and evaluate cells with sun simulators, airplane and balloon flights will conclude the two-day meeting.

The conference is sponsored by the IEEE's Technical Committee on Energy Sources (Professional Technical Group on Electron Devices) and is designed to be a working specialists' meeting. The Technical Committee on Electrical Power Systems of the American Institute of Aeronautics and Astronautics is the co-sponsor.

Paul Rappaport, Radio Corporation of America Laboratories, is Conference Chairman and his committee includes: A. Potter, NASA Lewis; W.R. Cherry, NASA Goddard; W.C. Scott, NASA Headquarters; J. Wise, WADD; M.B. Prince, Electro-Optical Systems; M. Wold, Heliotek; J.J. Loferski, Brown University; and J. Blair, Massachusetts Institute of Technology.

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FOR RELEASE: IMMEDIATE

Release 64-53

Henry T. Jacques
(res: 251-1047)

CLEVELAND, Ohio, June 5 -- College professors from nine states will take part in a unique summer program at the National Aeronautics and Space Administration's Lewis Research Center.

Twelve young professors and instructors, all teachers in engineering and the physical sciences, have been accepted for the first session of the program -- known as the NASA Summer Faculty Fellowships.

For 10 weeks beginning June 15, the Fellows will work on significant space research projects at Lewis and will attend a special graduate level course in chemical rocket technology at Case Institute of Technology.

The participants and the institutions they represent are:

Dr. John M. Boyd and John W. Williamson, both of Ohio State University; Victor A. Richley, Youngstown University; Dr. Robert Pfeffer, City College of New York; Dr. Walter Lowen, Union College, Schenectady, N.Y.; Dr. George M. Hoerner, Jr., LaFayette College, Easton, Pa.; Dr. Don J. Wood, Duke University, Durham, N.C.; Francis R. Toline, Tennessee Polytechnic Institute, Cookeville, Tenn.; Dr. Randolph B. Renda, University of Kentucky, Lexington, Ky.; Gary G. Paulson, Southern Illinois University, Carbondale, Ill.; Jerry L. Hall, Iowa State University, Ames, Iowa; Dr. Dan L. Taylor, South Dakota School of Mines and Technology, Rapid City, S.D.

- more -

Commenting on the fellowships, Dr. Walter T. Olson, assistant director at Lewis, said: "The program is expected to have widespread benefits. The educators who participate will update and expand their professional knowledge. This knowledge will enrich the teaching and research work done at the participant's college or university. And we expect the experience to be a stimulating and useful one for our own staff members."

Most of the participants are in need of furnished houses and apartments for rent in the southwestern area of Greater Cleveland for the duration of the 10-week program. Housing is being sought by Dr. C.D. Ferraro, of the Lewis staff, telephone 433-4000, ext. 594.

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FOR IMMEDIATE RELEASE

Release 64-54

Hugh W. Harris
(res: 681-9354)

CLEVELAND, Ohio, June 17--More than $239.4 million in major contracts were awarded during May by the National Aeronautics and Space Administration's Lewis Research Center here in support of its space research and development programs.

Contracts of $25,000 or more went to companies in 13 states. They are listed alphabetically by state and city.

CALIFORNIA:	$237,583,873
Fullerton	Preston Scientific, $26,725, amplifiers and rocket module mountings.
Los Angeles	Cinerama Camera Corp., $25,000, 16 mm camera plus 1200 ft. magazine.
Palo Alto	Varian Associates, $70,797, vacuum chamber and pumping system.
Pasadena	Aerolab Development Co., $56,322, fabricate and test load two sets of hardware.

- more -

CALIFORNIA (Continued)	
Redondo Beach	Thompson, Ramo Wooldridge, Inc., $58,695, studies of micrometeorite bombardment initiating discharges and breakdown in ion thrustors.
San Carlos	Litton Precision Products, Inc., $98,374, analysis of electron ion mixing in ion engines.
San Diego	General Dynamics Corp., $247,960, co-axial plasma gun study. General Dynamics/Astronautics, $237,000,000, definitizator of letter contract for development of Centaur launch vehicle.
CONNECTICUT:	$73,913
East Hartford	United Aircraft Corp., $73,913, determination of emissivity of materials to be used in radiators for nuclear electric power generating systems.
GEORGIA:	$49,754
Valdosta	Martin Gracey Co., $49,754, labor, service and materials, equipment and supervision necessary to clean interior of buildings of Lewis Research Center.
MASSACHUSETTS:	$414,897
Cambridge	Massachusetts Institute of Technology, $28,810, investigation of fluid jet amplifier stability.

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MASSACHUSETTS (Continued)	
Everett	Monsanto Research Corp., $145,303, study of fuel cells using storable rocket propellants. Monsanto Research Corp., $240,784, development of the dry battery concept.
MICHIGAN:	$29,626
Detroit	Gem Tool & Die, $29,626, sodium turbine parts.
MINNESOTA:	$95,700
St. Paul	Minnesota Mining & Manufacturing Co., $95,700, honeycomb UO_2 specimens.
NEW JERSEY:	$59,920
Princeton	Electro-Mechanical Research Inc., $59,920 analog decommutator system.
NORTH CAROLINA:	$77,350
Charlotte	Douglas Aircraft Company, Inc., $77,350, second stage hardware for Wasp sounding rocket.
OHIO:	$608,141
Cleveland	Viking Steel Co., $34,681, stainless steel tubing. Barshaw Chemical Co., $97,693, development of cadmium-sulfide photovoltaic film cells.

- more -

OHIO (Continued)	
Columbus	Ellsberry Contractor, $37,995, service, labor and materials for the installation and testing of the liquid hydrogen burn-off system at Plum Brook Station. Cryovac, Inc., $74,840, service, labor, and material to design, fabricate, install and test a LH_2 transfer system at Plum Brook Station.
Fremont	Valley Electric Co., $27,450, service, labor and material to install and connect a data acquisition system at Plum Brook Station. T. O. Murphy Co., $39,460, service, labor and material for installation of a steam generation and distribution system at the Plum Brook Station.
Mansfield	R. G. Beer Corp., $194,572, service, labor and material to modify control room and test area at the Plum Brook Station.
Oberlin	T. O. Murphy Co., $101,450, service, labor and materials for installation of off-plot utility piping for the Spacecraft Propulsion Research Facility at Plum Brook Station.
PENNSYLVANIA:	$187,831
Hatboro	Daystrom Inc., $76,867, electrohydraulic serdo actuators. Weston Instruments, $49,824, two ten-channel function programmers.
Philadelphia	General Electric, $61,140, research on the visco-plastic solution of hypervelocity impact by low-density heterogeneous projectiles.

TENNESSEE:	$108,874
Oak Ridge	Atomic Energy Commission, $108,874, water flow test apparatus.
VIRGINIA:	$127,033
Falls Church	Melpar, Inc., $127,033, development of polymeric materials to provide adequate liners and expulsion bladders in cryogenic propellant tanks.
WISCONSIN:	$40,545
Beloit	Fairbanks, Morse & Co., $40,545, motor driven compressor.

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FOR IMMEDIATE RELEASE

Release 64-55

Hugh W. Harris
(res: 681-9354)

CLEVELAND, Ohio, June 18--Wind tunnel tests recently completed at the Lewis Research Center here studied the aerodynamic forces which will occur when Mariner spacecraft are launched toward Mars late this year.

The boost phase, while the spacecraft is being carried into space by the launch vehicle, is the first of many critical points in Mariner's long flight. During this part of the flight, the vehicle can encounter severe structural loads that are caused by large pressure differences on the surface.

Both an over-the-nose design, which involves a new separation technique, and a back-up pyrotechnic shroud were tested in Lewis' 8x6 foot supersonic wind tunnel. In the primary design, the second stage Agena is narrower than the Mariner-C shroud. Bobby W. Sanders, Project Engineer for these tests, explained that this sudden decrease in diameter creates a region of "aerodynamic flow instability"--a region where air flowing past the shroud can separate and cause significant pressure fluctuations that could damage the shroud structures and might lead to destruction of the entire vehicle.

The tunnel tests simulated actual launch and boost environments on scale models of the shroud and the Agena second stage vehicle. The model was tested over a range of speeds from Mach 1.56 (1.56 times the

- more -

speed of sound) to Mach 1.96. Sanders explained that the most critical portion of the Mariner boost lay between Mach 0.70 and Mach 0.90.

In the 8x6 foot tunnel, fluctuating pressures on the models were measured with dynamic pressure pickups. Static pressure profiles have been measured in wind tunnels frequently, but high frequency dynamic pressure measurements are relatively new. In the Mariner tests, frequencies between 20 and 10,000 cycles per second were measured. Because the tunnel model is a reduced scale version of the full-scale vehicle, these frequencies correspond to 2 to 1000 cycles per second in actual flight.

To identify the "aerodynamic noise" created by the tunnel itself, an empty tunnel test was made with the pressure transducers mounted on the tunnel walls. The data recorded during these tests are currently being analyzed.

In continued testing, the shroud model was tested in the 10x10 foot supersonic wind tunnel which runs from Mach 2.0 to 3.5. Thus, with both tunnels, the Mariner shroud will have "flown" several complete missions long before its actual launch date.

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FOR IMMEDIATE RELEASE

Release 64-56

Hugh W. Harris
(res: 681-9354)

CLEVELAND, Ohio, June 23--The National Aeronautics and Space Administration's Group Achievement Award was presented today to Centaur "E" Stand Project personnel at the Lewis Research Center's Plum Brook Station. This is the first time the award has ever been given to a Lewis group.

The citation to the 12 man team from James E. Webb, NASA Administrator, was presented by Dr. Abe Silverstein, Lewis Director. The citation reads, "For significant contributions resulting in the successful completion of research testing of the Atlas 116 D booster under simulated loading and environmental conditions and providing data vital to the first flight of the Centaur vehicle." The team also received cash awards ranging from $50 to $275 for their efforts which resulted in tangible savings of $30,000 and many intangible benefits to the government.

"E" Stand is a huge test stand capable of holding a complete Atlas-Centaur vehicle. Erected at Plum Brook Station near Sandusky, Ohio, the stand subjects the launch vehicle to the same stresses, vibrational forces and aerodynamic heating it would encounter during a launch.

Centaur, being developed under the management of the Lewis Research Center, is the nation's first launch vehicle to use the high energy liquid hydrogen-liquid oxygen propellant combination. Its prime mission is to

- more -

launch the Surveyor spacecraft toward a soft landing on the moon to pave the way for manned exploration.

Since Centaur is the heaviest load ever boosted by an Atlas, it was important to determine whether or not the Atlas was capable of lifting it before an actual launch could take place. Centaur was successfully launched on November 27, 1963.

Receiving awards were:

CLEVELAND:

William E. Thompson	11503 Heatley Avenue

HURON:

Russell L. Koger	206 Canton Avenue
Norman L. Schroeder	301 Forest Hills Drive

NORWALK:

Darrell H. Baldwin	195 West Main Street

PORT CLINTON:

Donald M. Entrikin	Route 1

SANDUSKY:

Donald Cooksey	5004 Dallas Avenue
Lawrence C. Gentile	2905 Milan
Joseph V. Gillette	1809 Pipe Street
Ernest King	519 Neil Street
Alvin E. Schultz	1316 Columbus Avenue
Robert D. Siewert	2823 Hinde Avenue
George L. Thomas	3815 Columbus Avenue

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FOR IMMEDIATE RELEASE

Release 64-57

Hugh W. Harris
(res: 681-9354)

CLEVELAND, Ohio, June 24--Twenty-nine employees of the National Aeronautics and Space Administration's Lewis Research Center are receiving commendations today for sustained superior performance for six months or longer.

The commendations include cash awards up to $425.

All NASA employees are eligible for the awards which are presented under the authority of the Government Employees Incentive Awards Act.

Employees in administration, development, research and technical services at Lewis and its Plum Brook Station near Sandusky were honored. Their awards were earned for contributions in fields ranging from pipe-fitting on a stand for testing the country's first nuclear rocket engine to outstanding leadership in research efforts on solar cells.

Receiving awards are:

AVON:

Joseph A. Ziemianski 37898 Lorie Boulevard

- more -

CLEVELAND:

Harry M. Cameron	3339 Meadowbrook Boulevard
John T. Flynn	2392 Garden Avenue
Lloyd R. Hunt	26460 Parklawn Drive
Norman C. Prahst, Jr.	4827 West 97th Street
McKinley Ray	8816 Yale Avenue
Laurence Schwartz	27421 Sidney Drive
William G. Spiegelberg	4228 Fulton Parkway
Fred F. Terdan	13909 Clifford Avenue

CORTLAND:

Henry A. Diehl	Route 3

FAIRVIEW PARK:

Betty J. Hood	4751 West 210 Street

FREMONT:

Ivan R. Franks	1141 East Cole Road

GARFIELD HEIGHTS:

John Cruickshank	12316 Park Knoll Drive

LODI:

Harold L. Weitzal	705 Bank Street

LORAIN:

Erwin J. Gutoske	1109 West 21st Street

MAPLE HEIGHTS:

Howard A. Molzan	20904 Franklin Road

- more -

MILAN:

Robert C. Didelot	53 Main Street

NORTH RIDGEVILLE:

Frank L. Hren	7082 R. D. 1

NORTH ROYALTON:

Frank J. Kuchta	11373 Ridge Road

NORWALK:

John E. Sholes	R. D. 1

OLMSTED FALLS:

Thomas F. Davis	9090 Lindberg Boulevard
Michael M. Modic	6801 Lewis Road

PARMA:

William J. Masica	3806 Walter Avenue
Michael C. Schneider, Jr.	8109 Newport Avenue
Eugene J. Tomasck	5897 Twin Lakes Drive
Leonard J. Tesar	6714 Wilber Avenue

SANDUSKY:

James H. Hurst	808 Vine Street
Ernest L. Rooks	515 Perry Street

STRONGSVILLE:

Thomas Buchar	8442 Big Creek Parkway

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FOR RELEASE: IMMEDIATE

Release 64-58

Hugh W. Harris
(res: 681-9354)

CLEVELAND, Ohio, June 25 -- The first four divisions of the National Aeronautics and Space Administration's Lewis Research Center have completed moving into the new Development Engineering Building.

The new building is the first structure Lewis has built on the north side of Brookpark Road. An annex to the new building is also under construction now and should be completed by the end of the year.

A new road and underpass has also been built to relieve possible congestion on heavily traveled Brookpark Road. Use of underpass eliminates left hand turns on Brookpark into Lewis.

The new building was started in November 1962. It was needed to relieve crowded conditions which had made it necessary to rent space in the Fairview Shopping Center.

Completed cost of the two new buildings, roads and underpass will be approximately $4 million.

The first divisions to move into the new building include Personnel, Chemical Rocket Systems Division, M-I Project Office, Space Power Systems and Reliability & Quality Assurance.

By the end of summer all of the units including Procurement Division will be moved to the new building from Fairview Park. Other major development divisions such as Centaur, Agena and Finance will also occupy space in the new building.

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FOR IMMEDIATE RELEASE

Release 64-59

Hugh W. Harris
(res: 681-9354)

CLEVELAND, Ohio, June 26--Listening to the amplified sounds of metal cracking under strain is helping to make the supersonic transport possible according to William F. Brown, Jr., Chief of the Strength of Materials Branch of the National Aeronautics and Space Administration's Lewis Research Center.

Brown was chairman of the Symposium on Fracture Testing and Its Application sponsored by the American Society for Testing and Materials in Chicago this week. He and John E. Srawley, Head of the Fracture Section at Lewis, presented a paper on fracture toughness test methods. Brown also chaired a panel discussion covering all aspects of fracture mechanics.

This was the first symposium ever held by ASTM's Special Committee on Fracture Testing of High Strength Materials. Brown is one of the original members of the committee which was founded in 1959 at the request of the Defense Department. At that time the Navy was having a great deal of trouble with the Polaris missile. Even though it was being manufactured from a high-yield strength steel, it was blowing up during flight, in hydrostatic testing and even during manufacture. The failure was caused by brittle fracture because of the low-notch toughness of high strength materials containing cracks such as weld cracks, bead starter craters and tiny inclusions. The committee immediately realized that low-cost, simple fracture toughness testing methods had to be developed and people working in design and manufacture educated about the necessity and use of such tests.

- more -

Within a few months after the committee was formed, the pieces of the Polaris puzzle began to fall into place. Much of the information came from laboratories like Lewis where fracture studies were being conducted. The committee provided the missing pieces and soon the Navy had a dependable missile.

Polaris was only the first program to benefit from the fracture committee. Every major structure since that time, in which high strength is important, has benefited--from Minuteman up to the Saturn vehicle. Brown says although there is still work to be done, a great deal of progress has been made in developing fairly simple, short-term tests for determining how well high strength materials will stand up under strain over long periods of time.

At Lewis, the problem of obtaining more information about how a crack progresses from its starting point to where it becomes unstable and sudden failure occurs, is being studied. "Contrary to what you might expect," Brown says, "even a sharply notched specimen of material under stress, if it has any fracture toughness, does experience some slow crack growth before failure finally occurs."

Three techniques are presently being used here to study this phenomenon.

1. A metal strip instrumented with foil resistance strain gauges is wedged between grooves on either side of a crack in a test piece of metal and measures displacement during the test.

2. An electric current is sent through a specimen under strain, and probes measure the potential drop across the crack. This change in potential drop, measured in parts of microvolts, detects the minute growth of a crack that occurs in sudden tiny spurts.

3. A crystal phonograph pick-up attached to a specimen under tests, picks up the tiny explosive noises (or pops) the metal makes as a crack grows in it.

Brown says there is a growing future for fracture toughness testing. "High strength hardware has to be designed on the basis of fracture tests rather than deformation or tensile strength tests. Such fracture tests are of great value in projects like supersonic transports.

"We have made tremendous progress, but there is still work to be done in developing new tests and in learning to more carefully analyze and interpret the results of the test we now have."

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FOR RELEASE: IMMEDIATE

Release 64-61

Hugh W. Harris
(res: 681-9354)

LRC
Plum Brook

CLEVELAND, Ohio, JUN 29 1964 -- The National Aeronautics and Space Administration today awarded a $16,975,000 contract to Blount Brothers Corp. of Montgomery, Alabama, for construction of three major elements of a unique space environment facility.

Known as the Space Propulsion Facility, it will be built at NASA's Plum Brook Station near Sandusky, Ohio. It is scheduled for completion in 1967.

The facility, designed by Kaiser Engineers, Oakland, Calif., will have the capability to simulate temperature and pressure conditions existing at altitudes up to 100 miles above earth. This will permit evaluation and developmental testing of complete spacecraft, chemical propulsion systems and nuclear electric power generation and propulsion systems.

Heart of the facility will be a cylindrical vacuum chamber 100 feet in diameter and 120 feet high. Reinforced concrete, six feet thick, will surround it and provide shielding against nuclear radiation.

Adjacent to the chamber will be an office building, control building, and spacecraft assembly and disassembly facilities.

The Plum Brook Station, which also includes a 60 megawatt research reactor, is a facility of NASA's Lewis Research Center in Cleveland.

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T/LRC

FOR RELEASE: IMMEDIATE

Release 64-64

Henry T. Jacques
(res: 251-1047)

CLEVELAND, Ohio, July 22 -- The Terminal Tower -- Cleveland's tallest building -- has a new distinction.

It's long been a widely-known office building, railroad terminal, sightseers' attraction, Public Square landmark, and skyline highpoint.

And now it has something in common with a facility for the study of the space-age phenomenon of weightlessness. A series of successful experiments conducted at the Terminal Tower aided in the design of a deceleration device for a Zero-Gravity Facility now under construction at NASA's Lewis Research Center.

Excellent results were obtained in 18 experimental drops down one of the main elevator shafts of the 752-foot-high building--the only one of suitable height in the area--says Terrence E. Russell, design engineer.

Russell recently issued a report summarizing the data obtained and conclusions drawn from the Tower test series, conducted on May 2, 3 and 16, 17.

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Objective of the experiments was to prove the capability of styrofoam for use as a deceleration medium in Lewis' new 500-foot Zero-Gravity Facility. The styrofoam was under consideration as the filler for a cart which will be used to "catch" free-falling test packages in the facility.

In the Tower tests, a 43-pound, steel projectile was dropped from an elevator at heights up to 400 feet into a 1-foot-diameter cylinder filled with styrofoam.

From the tests, Russell concludes in his report that the use of styrofoam has been verified and specifications can be finalized.

He adds that the deceleration cart design for the new facility is deemed satisfactory for its proposed use.

Furthermore, the tests showed that a variety of test packages can be decelerated with the styrofoam-filled cart, Russell reports.

Some 230 drop tests were conducted by Lewis engineers in search of the proper material for use in the cart.

The Zero-Gravity Facility will be used for the study of weightlessness effects on liquid and vapor systems, a problem for any space vehicle required to coast during part of its mission.

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FOR RELEASE: IMMEDIATE

Release 64-68

Hugh W. Harris
(res: 681-9354)

CLEVELAND, Ohio, August 6 -- More than $31 million in major contracts were awarded during June by the National Aeronautics and Space Administration's Lewis Research Center here in support of its space research and development programs.

Contracts of $25,000 or more went to companies in 20 states and Canada. They are listed alphabetically by state and city.

ALABAMA:	$17,082,130
Huntsville	Thiokol Chemical Corp., $107,130, solid fuel rocket motors.
Montgomery	Blount Brothers, $16,975,000, service, labor and material for construction of Space Propulsion Facility.

- more -

CALIFORNIA:	$3,419,541
Azusa	Aerojet General, $124,625, design improvements in liners for glass fiber filament wound tanks to contain cryogenic fluids.
Bell Gardens	Pacific Scientific Co., $32,250, bell type vacuum furnace.
Canoga Park	North American Aviation, $82,449, fabrication of WUO_2 cylinders. North American Aviation, $119,000, investigation of catalytic ignition of hydrogen-oxygen systems. North American Aviation, $135,445, dynamic analysis of a split feed system for a rocket motor.
Hawthorne	Cosmodyne Corp., $31,790, conversion of two LO_2 dewars to LN_2 storage and transport dewars. Cosmodyne Corp., $163,850, LH_2 semi-trailer storage and transport dewar.
Malibu	Hughes Aircraft Co., $259,105, development of linear strip ion thrustors for attitude control.
Menlo Park	Stanford Research Institute, $143,000, evaluation of ozone defluoride as a liquid propellant additive.
Mountain View	Vidar Corp., $28,940, transistorized FM reproduce and record electronics.
Newport Beach	Philco Corp., $95,972, program to develop a high energy battery capable of operation for three days at 800^{o} F. in an environment approximately the same as the planet Venus.

CALIFORNIA (Cont.)

Palo Alto	Varion Associates, $26,935, procurement of a linear accelerator tube. Varian Associates, $39,060, low energy electron diffraction system.
Pasadena	Electro-Optical Systems, $197,012, investigation of performance limits of a magnetic annular hall accelerator.
Redondo Beach	Space Technology Lab., $112,100, investigation of basic systems for improved ablative materials. Thompson Ramo Wooldridge, Inc., $71,159, study to develop a low temperature battery and table for space probe applications.
San Diego	General Dynamics, $90,075, joining of tungsten uranium dioxide composites.
Santa Barbara	General Motors Corp., $239,822, investigation of space radiator projection from meteoroid.
Santa Monica	Douglas Aircraft Co., $144,500, conduct research and development on an inorganic ion exchange membrane fuel cell. Douglas Aircraft Co., $185,416, hypervelocity impact effects on liquid hydrogen tools. Douglas Aircraft, $219,325, research on growth of plane-stress flaws in thin walled cryogenic material. Douglas Aircraft Co., $66,052, program to develop an inorganic separator for a high-temperature silver zinc battery.
Sunnyvale	Lockheed Aircraft, $538,955, development of thermal protection system for a cryogenic spacecraft module. Lockheed Aircraft, $245,000, propellant tank for cryogenic pressurization and dynamics program.

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CALIFORNIA (Cont.)	
Torrance	General Technology Corp., $27,704, development and testing of a magnetic induction plasma engine.
CANADA:	$117,945
Ottawa	Canadian Commercial, $117,945, meteoroid impact bumper program.
CONNECTICUT:	$2,182,532
East Hartford	United Aircraft Corp., $939,391, research and development of high performance axial flow turbomachinery. United Aircraft Corp., $1,129,534, research and development for high performance turboalternator and associated hardware.
Hamden	Unholte-Dickie Corp., $25,230, automatic calibration system for determining either the voltage or charge sensitivity of piexoelectric accelerometers.
Milford	Huyck Corp., $38,934, characterization of large internal surface area nickel metal plaques.
New Haven	Textron Electronics, $49,443, 5,000 pound force electrodynamics vibration systems.
FLORIDA:	$680,762
Ft. Lauderdale	Systems Engineering Laboratories, Inc., $36,512, central timing system, tape search system, and remote timing system.
West Palm Beach	United Aircraft Corp., $644, 250, investigation of light hydrocarbon fuels with FLOX mixtures as liquid rocket propellants.

IDAHO:	$86,000
Idaho Falls	U. S. Atomic Energy Commission, $86,000, chemical processing of irradiated reactor material to separate and recover special nuclear material contained therein in the form of purified nitrate salts of uranium.
ILLINOIS:	$172,206
Harvey	Whiting Corp., $59,345, 20 ton traveling crane.
Palatine	Nuclear Data, Inc., $33,681, multi-channel analyzers.
Springfield	Sangamo Electric Co., $35,100, tape transport and 14 channel reproduce electronics. Sangamo Electric Co., $44,080, instrumentation recorder.
INDIANA:	$268,438
Indianapolis	General Motors Corp., $29,550, analytical computing with existing digital nuclear codes, plottings, analysis and reporting of gaseous fueled cavity reactors for nuclear propulsion. P. R. Mallory & Co., $144,448, program to develop high energy density secondary batteries capable of producing 150 watt hours per pound of battery weight.
South Bend	Bendix Corp., $94,440, development of an improved actuator motor.
KENTUCKY:	$39,000
Paducah	Atomic Energy Commission, $39,000, injector assemblies.

MASSACHUSETTS:	$290,993
Burlington	Magnion, Inc., $39,150, beam transport system.
Wilmington	AVCO Corp., $251,843, continuation of arc jet research and development program.
MICHIGAN:	$193,608
Southfield	Bendix Corp., $131,459, replacement of electronics with fluid interaction devices. Bendix Corp., $26,144, hydrogen steam ratio sensor. Bendix Corp., $36,006, design, fabrication and test of fluid interaction device.
MINNESOTA:	$80,246
St. Paul	Program & Remote Systems Corp., $80,246, remote controlled manipulator.
NEW HAMPSHIRE:	$154,055
Concord	Richard D. Brew & Co., $99,680, vacuum creep rupture testing equipment. Richard D. Brew & Co., $54,375, horizontal type vacuum furnace system.
NEW JERSEY:	$281,212
Harrison	Radio Corporation of America, $55,000, emissivety and mass flow installation. Radio Corporation of America, $37,575, one lubricant screening apparatus.
Long Branch	Electronic Association, Inc., $30,659, analog computer, pre-patch panels and patching kits.

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NEW JERSEY (Cont.)	
Matuchen	Culton Industries, $51,753, investigation of battery active nickel oxides.
Morristown	Allied Chemical Corp., $25,000, materials necessary to furnish gaseous oxygen difluoride.
Union	Tenney Engineering, $81,225, high vacuum thermal test chamber.
NEW YORK:	$788,925
Buffalo	Bell Aerospace Corp., $28,5000, thrust chamber assemblies.
Schenectady	General Electric, $146,713, development of high-temperature, high-current, alkali-metal, vapor-filled ceramic thyratrons and rectifiers.
Elmsford	Senotone Corp., $49,043, research and development program directed toward the improvement of nickel cadmium cells.
Farmingdale	Republic Aviation, $99,380, conduct of a program for experimental and analytical investigation of an externally heated thermionic converter.
Grand Island	Edwards High Vacuum, Inc., $51,531, vacuum booster pump with drive motor.
Rochester	Consolidated Vacuum Corp., $62,000, oil diffusion type vacuum.
Tonawanda	Union Carbide Corp., $65,858, superconducting magnet and dewar assembly.

NEW YORK (Cont.)

White Plains — United Nuclear Corp., $99,207, joining of n-$UO_2$ composites. United Nuclear Corp., $186,693, gamma heating study.

OHIO: — $3,275,249

Akron — Goodyear Aerospace Corp., $26,727, controlled perforation development of multi-foil insulation and controlled crinkling of the multi-foil to permit adequate venting of gases. Akron Steel Fabrication, $51,000, service, labor and materials to fabricate, test and deliver seventeen gaseous bottle storage racks.

Cincinnati — General Electric Co., $78,340, determination of affects of control elements and xenon on the fuel element power distribution. Nardco Scientific Corp., $61,167, secondary emission microscope. General Electric, $93,226, capsule testing program to examine the influence on stress on the corrosion resistance of an advanced refractory alloy in potassium and to investigate the corrosion mass transfer of elements from stainless steel to a refractory alloy in a potassium enviornment.

Cleveland — Acme Roofing, $26,748, service, labor and materials for repairing roof and fleshing at the Engine Research Building. General Electric Co., $29,695, nuclear instrumentation system. R. J. Platten, $47,206, service, labor and material for construction of two metal buildings at the Propulsion Science Laboratory. Clevite Corp., $36,860, graphic recorder. Chicago Bridge & Iron, $449,800, dewar-liquid hydrogen. Honeywell, Inc., $32,050, oscillographs and DC calvanometers.

OHIO (Cont.)

Cleveland (Cont.)	Associated Builders Corp., $568,000, service, labor and materials for construction of a Service Building for the zero-gravity research facility at the Lewis Research Center. Thompson Ramo Wooldridge, $288,148, fatigue properties of refractory alloys. Warwick Communications, $31,260, closed circuit TV system. Thompson Ramo Wooldridge, $298,313, improved throat inserts for ablative for thrust chambers. Bell Aerospace Corp., $54,430, purchase of two three-axis accelerometer systems. Thompson Ramo Wooldridge, $93,000, procurement of ion engine simulator. C. P. Wright & Co., $89,058, service, labor and material to install a MHD plumbing system in Cell CR 1, Engine Research Bldg.
Columbus	Battelle Memorial Institute, $122,950, fabrication of tungsten-uranium dioxide composites fuel elements. Battelle Memorial Institute, $99,730, development of large internal surface area nickel metal plaques. Elsberry Contractor, $118,500, services, labor and materials for installation of cryogenic propellant pressurization and dynamics testing facility at Plum Brook Station. Battelle Memorial, $54,800, joining N UO_2 composites.
Dayton	Monsanto Research Corp., $70,134, research and development program on improved single crystal gallium phosphide solar cell.
Fremont	Valley Electric Co., $112,755, service labor, equipment and material for installing and connecting a complete instrumentation system for the Nuclear Rocket Dynamics and Control Facility at the Plum Brook Station.

OHIO (Cont.)	
Fremont (Cont.)	Valley Electric Co., $190,450, service, labor and materials for the installation of the control, instrumentation and warning systems for the cryogenic propellant pressurization and dynamics test rig at Plum Brook.
Lima	Westinghouse Electric Corp., $70,290, design, develop, fabricate, test and deliver an experimental model of a power converter for ion thrustors.
North Royalton	Hannon & Nousak, $30,703, services, labor and materials for construction of a sanitary sewer and a natural gas line at the Lewis Research Center.
Solon	Acme Construction Co., $49,909, reactivation of existing railroad and construction of new railroad spur tracks at Plum Brook Station.
OREGON:	$96,907
McMinnville	Field Emission Corp., $96,907, continuation of research program on the behavior of various adsorbates on metal substrates.
PENNSYLVANIA:	$2,182,112
Apollo	Nuclear Materials & Equipment, $45,052, fabrication of W HO_2 cylinders.
Hatboro	Weston Instruments, $30,212, solid state serve amplifiers. Weston Instruments, $45,500, dual channel spectrum analyzer.
Monroeville	Heraeus-Englhard Vac., $36,950, electron beam vacuum furnace.

PENNSYLVANIA (Cont.)

Montgomeryville	Livingston Electronics Corp., $96,982, development of high energy density primary batteries, 200 watts hour per pound of total battery weight minimum. Livingston Electronic Corp., $69,607, program to develop a long temperature battery for space probe application.
Philadelphia	U.S. Army Material Co., $50,000, fracture toughness of parent and weld metals for cryogenic tanks.
Pittsburgh	Pitts-Des Moines Steel, $365,900, services, labor and materials for the fabrication and creation of vacuum chamber and accumulator tank for the zero gravity research facility. Westinghouse Electric, $81,765, services for compatibility evaluation and for writing of manual. Westinghouse Electric, $78,366, dynamic analysis of a nuclear rocket system. Westinghouse Electric, $46,151, development of a fluoride process for vapor deposition of tungsten costing. American Optical Co., $496,500, three axis simulators. American Optical Co., $97,434, procurement of gyro test stand facility. Westinghouse Electric, $373,000, feasibility study of a rocket control system. Westinghouse Electric, $48,200, engineering design and development to improve plasma jet radiant energy source.
Towanda	Sylvania Electric, $39,067, vapor desposition of tungsten cladding on tungsten-uranium dioxide composite. Sylvania Electric, $30,686, joining of tungsten-uranium dioxide composites.
Washington	National Annealing Box Co., $31,246, propellant storage and pressurization vessels.

West Chester	Aeroprojects, $119,494, advancement of state of the art of liquid hydrogen for use in rocket fuels.
TENNESSEE:	$215,289
Lawrenceburg	Union Carbide Corp., $26,289, determination of youngs modules for tungsten uranium sioxide composites.
Oak Ridge	U.S. Atomic Energy Commission, $61,100, graphite sphezes. U.S. Atomic Energy Commission, $127,900, hot isothermal fuel element test apparatus.
VIRGINIA:	$145,000
Richmond	Texaco Experiment, $145,000, investigation of fiber systems for improved ablative materials.
WASHINGTON:	$259,326
Seattle	Boeing Co., $199, 035, research on plane strain flaw growth in thick walled tanks. Boeing Co., $60,291, space environment tests on thin film solar cells.
WISCONSIN:	$89,933
Milwaukee	Globe-Union, Inc., $89,933, a program to develop a high energy density primary battery with a minimum of 200 watt hours per pound of total battery weight.

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News

NASA LEWIS RESEARCH center

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PUBLIC INFORMATION OFFICE

PHONE - (AREA CODE 216) 433-4000 EXT. 415

FOR RELEASE: IMMEDIATE

Release 64-72

Lynn Manley
(res: 243-3489)

CLEVELAND, Ohio, Aug. 7 -- A Centaur space vehicle, complete with twin high-energy rocket engines, will highlight the National Aeronautics and Space Administration's display during Cleveland's Parade of Progress exhibit, Aug. 28 through Sept. 7.

The NASA display, covering some 14,000 square feet, is being coordinated by the Lewis Research Center as a major attraction of the 11-day public exhibit designed to commemorate the opening of the new Cleveland Convention Center, now one of the world's largest. More than 200 Cleveland-area firms and industries are participating.

In addition to the Centaur vehicle, NASA will include many displays and exhibits planned to show the progress of aerospace during the past 20 years. Full-scale spacecraft, including the successful Ranger and Mariner, will be exhibited, along with models of nuclear and electric propulsion systems, air-breathing engines, rocket launch vehicles, proposed supersonic aircraft designs, manned spacecraft, and future vehicles.

A special exhibit will include lunar pictures returned by Ranger 7 during its recent photographic mission to the moon.

- more -

Also on display will be the SERT (space electric rocket test) spacecraft which was launched from Wallops Island, Va., on July 20, 1964 in the first successful test of electric rocket engines in space. One of the two engines aboard the spacecraft was invented by a Lewis scientist.

A major portion of the Lewis exhibit will be devoted to a Space Science Theater which will provide hourly lectures and films describing the U.S. space program. This proved to be an extremely popular attraction during the 1962 Space Science Fair, also held at Cleveland Public Hall.

As the second stage of an Atlas-Centaur vehicle, Centaur was the first high-energy space vehicle to be operated in space. Its initial successful development engineering launch occurred on Nov. 27, 1963, followed by a second successful mission last June 30.

Centaur is being developed for NASA by General Dynamics/ Astronautics, San Diego, Calif., under the technical direction of Lewis. When operational, it will carry instrumented Surveyor spacecraft to the moon to conduct lunar surface studies in support of later manned landings.

The Parade of Progress exhibit is free to the public. It will be open daily from 11 a.m. to 11 p.m.

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FOR RELEASE: IMMEDIATE

Release 64-73

Lynn Manley
(res: 243-3489)

CLEVELAND, Ohio, Aug. 13 -- A full-scale engineering model of Ranger, which returned history's first close-up pictures of the moon, will be displayed by the National Aeronautics and Space Administration during the Parade of Progress exhibit here August 28 through September 7.

The Ranger model, virtually identical to the successful Ranger 7 spacecraft that transmitted 4,316 photographs of the moon's surface to earth on July 31, will be shown in the NASA Lewis Research Center's exhibit at Public Hall.

Included with Ranger will be a selection of photos of the lunar surface. Photographs will be shown from the time Ranger's cameras began recording -- about 1,120 miles above the lunar surface -- until the spacecraft hit the moon. The last picture, showing craters three feet wide and a foot deep, was taken about 1,000 feet above the moon's surface.

The Ranger spacecraft is being sent to the Parade of Progress from the Jet Propulsion Laboratory, Pasadena, Calif., which conducts NASA's lunar and planetary exploration program. The Lewis Research Center has technical direction of the Atlas-Agena-B launch venicle which launched the Ranger 7 spacecraft on its historic trip to the moon.

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Also scheduled to be shown is a full-scale model of Mariner which flew past the planet Venus on Dec. 14, 1962 and transmitted to earth valuable information about the planet.

The Lewis Research Center is preparing a 14,000 square foot exhibit area for the Parade of Progress show, which will commemorate the opening of the new Cleveland Convention Center.

Part of the NASA exhibit will be devoted to a Space Science Theater which will include hourly public lectures and films about the U.S. space program.

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FOR RELEASE: IMMEDIATE

Release 64-75

Lynn Manley
(res: 243-3489)

CLEVELAND, Ohio, Aug. 19 -- Clevelanders will get a preview of the Parade of Progress starting Friday, Aug. 21, when a full-scale replica of the National Aeronautics and Space Administration's two-man Gemini spacecraft will be displayed at Public Square.

Cleveland's Parade of Progress is being held in Public Auditorium Aug. 28 through Sept. 7 to dedicate the city's new convention facility. NASA's Lewis Research Center is one of more than 300 exhibitors participating in the show.

Gemini is America's newest manned spacecraft. The first unmanned Gemini flight test was conducted on April 8 of this year. Its launch by a Titan II rocket was highly successful. The first manned flight, with Astronauts Virgil I. Grissom and John W. Young, is scheduled later this year.

A trailer platform will make it possible for visitors to view the spacecraft display from all angles, including its interior.

The Gemini display is being furnished by McDonnell Aircraft, St. Louis, Mo., which is developing the spacecraft for NASA's Manned Spacecraft Center, Houston, Tex.

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Gemini is similar in shape to the Mercury spacecraft but weighs approximately twice as much and has 50 per cent more cabin volume in order to accommodate the two astronauts. Attached to the blunt end of the capsule is an equipment adapter to carry additional tanks of oxygen, fuel cells for electric power, and propellants needed for the longer duration flights.

The spacecraft is designed to remain in orbit for periods of up to two weeks. It will rendezvous and dock with another vehicle in orbit, allow an astronaut to leave the capsule for a short period of time and in later flights land on the earth rather than water. The Gemini capsule is a direct outgrowth of the knowledge gained during the Mercury program.

Gemini is an intermediate step between the simple orbital flights of the Mercury program and the complex manned Apollo mission to the moon. Rendezvous and docking is of particular importance to the moon mission since two of the Apollo astronauts will be leaving the primary spacecraft or command module and descending to the moon's surface in the lunar excursion module. After a period of exploration, they will rendezvous with the command module in orbit and transfer back for the journey home.

The Gemini capsule will be on display at Public Square through September 3.

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FOR RELEASE: IMMEDIATE

Release 64-79

Lynn Manley
(res: 243-3489)

CLEVELAND, Ohio, Aug. 25 -- The how and why of U.S. space exploration will be explained to the public at the National Aeronautics and Space Administration's Space Science Theater during Cleveland's Parade of Progress, Aug. 28 through Sept. 7.

NASA's Lewis Research Center is providing a 15,000 square foot exhibit, including the 500-person capacity Space Science Theater for the Parade of Progress show, being held to commemorate Cleveland's new Convention Facility. More than 300 Cleveland-area business, industrial, civic and cultural organizations are participating.

The exhibit, free to the public, will be open daily from 11 a.m. to 11 p.m.; the theater will provide space science lectures and films on the hour beginning at 1 p.m. each day.

The space lectures will be given by professionals as part of NASA's public education program. The lecturers operate throughout the U.S. and in many foreign countries in "Spacemobiles," traveling space science demonstration units designed primarily for student and teacher presentations. The unit includes models of major NASA launch vehicles and scientific satellites. Materials such as motion pictures, slides and illustrated publications along with scientific demonstrations supplement the presentation.

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An added feature at the Parade of Progress will be Astronaut Charles A. Bassett II, Ohio native and former Berea student who will make presentations in the Space Science Theater on Tuesday, Sept. 1 at 2 p.m. and 4 p.m. Bassett is expected to discuss the U.S. manned space flight program, including projects Gemini and Apollo.

A typical space science presentation is about 45 minutes long and answers six basic questions: (1) what is a satellite? (2) how does it get into orbit? (3) what keeps it in orbit? (4) what does it do? (5) what good is it? (6) what are NASA's plans for future research and space exploration?

It is planned to alternate several films with the space science demonstrations. Daily schedules will be posted at the entrances to the theater so that Parade of Progress visitors may plan to see a particular film about space or listen to a lecture.

The Space Science lectures proved quite popular during NASA's Space Science Fair held at Public Auditorium in late 1962. More than 100,000 persons heard the presentations during the 10-day show.

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NASA LEWIS RESEARCH Center

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PUBLIC INFORMATION OFFICE
PHONE - (AREA CODE 216) 433-4000 EXT. 415

August 26, 1964

Release 64-80

NOTE TO EDITORS:

To officially open Cleveland's Parade of Progress exhibit on Friday, Aug. 28, a two-way telephone conversation has been arranged between Mayor Locher in Cleveland and President Johnson in Atlantic City, N. J.

Following the telephone conversation, President Johnson will initiate an electrical signal which will turn on the fountains at the Leonard C. Hanna Memorial Gardens on the Mall above the new annex to Public Hall.

The telephone ceremony will take place at 11:45 a. m. in front of the mall entrance to the new convention facility. Appropriate Parade of Progress and city officials will be present.

We invite your coverage of this event. The program will be quite informal and brief. However, your representative should plan to arrive sufficiently in advance of 11:45 to be prepared when the call is placed. It will last about 10 minutes and will be amplified via a public address system so that the public and guests can hear the conversation.

If you have questions concerning this event, please call my office or Pat O'Toole, general manager, Parade of Progress, 523-2333.

Lynn Manley
Director of Public Information

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FOR RELEASE: IMMEDIATE

Release 64-86

Hugh W. Harris
(res: 681-9354)

CLEVELAND, Ohio, Sept. 22 -- More than $2.7 million in major contracts were awarded during July and August by the National Aeronautics and Space Administration's Lewis Research Center here in support of its space research and development programs.

Contracts of $25,000 or more went to companies in 14 states. They are listed alphabetically by state and city.

CALIFORNIA:	$263,630
Monrovia	Consolidated Systems, $132,170, pressure transducer calibration systems.
San Clemento	Lunar Engineering Corp., $44,060, pressure transducers.
Sunnyvale	Lockheed Aircraft, $87,400, heat rejection radiator and support structure.
FLORIDA:	$712,824
Ft. Lauderdale	Systems Engineering Lab., Inc., $712,824, digital data acquisition system.

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ILLINOIS:	$27,119
Chicago	General Services Administration, $27,119, furniture for D. E. B.
INDIANA:	$137,018
Indianapolis	FMC Corp., $137,018, intercondenser pumps.
MARYLAND:	$34,769
Baltimore	Martin Marietta Corp., $34,769, fabrication of tungsten uranium dioxide composites.
MASSACHUSETTS:	$534,052
Brockton	Process Equipment Co., $34,211, space simulator chamber system.
Wilmington	AVCO Corp., $499,841, resistojet research and development program.
MICHIGAN:	$181,846
Jackson	Commonwealth Assoc., $40,000, design of electric power substation, circuit breakers, transmission line and preparation of plans and specifications.
Southfield	Bendix Corp., $141,846, development of an all-fluid amplifier for liquid rocket application.
MISSOURI:	$63,067
St. Louis	Emerson Electric Mfg., $63,067, transpiration cooled nozzles with graphite throat insert material.
NEW HAMPSHIRE:	$71,655
Concord	Richard D. Brew Co., $40,055, ultra-high vacuum furnace.
Exeter	Sylvania Electric, $31,600, tungsten wire mesh heaters.

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NEW JERSEY:	$118,641
Hightstorm	Gardner Cryogenics Corp., $118,641, helium gas recovery loop.
NEW YORK:	$220,410
Buffalo	Birdair Structures, Inc., $25,357, replacement weather protective envelope. Cornell Aeronautical Laboratory, Inc., $90,393, pulsed laser ion generator study.
Schenectady	General Electric, $104,660, ionization test apparatus.
OHIO:	$223,548
Castalia	Borchardt Elmer, Inc., $47,173, resurfacing roads and construction of a new parking area.
Cleveland	Westinghouse Electric, $25,723, ultrasonic cleaning system. Suburban Piping, $25,188, services, labor and material to install a high pressure air line system for the 8x6 SWT Research and Control Building. Standard Electric, $37,700, service, labor and material to modify rooms in the Engine Research Building.
Columbus	CryoVac, Inc., $27,500, vacuum jacketed liquid hydrogen.
Parma	Union Carbide Corp., $60,264, program to improve fuel cell performance through pulsing techniques.
OREGON:	$31,125
Albany	Northwest, Inc., $31,125, neutron velocity selector.
PENNSYLVANIA:	$99,650
Bethlehem	Bethlehem Corp., $99,650, horizontal type environmental test chamber system.

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PHONE - (AREA CODE 216) 433-4000 EXT. 415

Release 64-88

Lynn Manley
(res: 243-3489)

CLEVELAND, Ohio, Oct. 2 -- The advantages of developing lightweight, low-power nuclear reactors for rocket engine applications were outlined by a NASA scientist this week at a meeting in Brussels, Belgium.

Frank E. Rom, chief of the Propulsion Concepts Branch of Lewis Research Center's Nuclear Reactor Division, spoke to the Advisory Group for Aeronautical Research and Development of the North Atlantic Treaty Organization.

In two papers, Rom discusses fast and moderated low-power, lightweight reactors and their applications. Both one- and two-stage nuclear rockets have significantly superior performance over the best chemical rocket systems, he states.

Potential missions with low-power reactors include manned interplanetary exploration as well as unmanned scientific probes. Rom also states that a final nuclear stage added to any present system from Atlas-Centaur to one as large as Saturn V would show significant increases in payload capability.

In one paper Rom states, "The development of a low-power nuclear rocket would be the quickest and least costly way to achieve a practical nuclear powerplant for space use. Since early use of these smaller powerplants would be possible, operational and flight experience would aid in the development of larger nuclear rockets."

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An extensive research program is being conducted at Lewis on nuclear energy applications for advanced propulsion and power generation systems for space vehicles. This work includes, for example, (1) thermodynamic and nucleonic requirements for nuclear systems, (2) research on reactor-system components for power generation and propulsion, (3) fundamental heat transfer and fluid flow studies, (4) advanced high-temperature refractory and composite materials for nuclear applications, and (5) fundamental studies of nuclear radiation effects and shielding problems.

In all these areas, the research activities are being carried out under the direction of the Space Nuclear Propulsion Office, a joint NASA-Atomic Energy Commission program.

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FOR RELEASE: IMMEDIATE

Release 64-92

Henry T. Jacques
(res: 251-1047)

CLEVELAND, Ohio, Oct. 14 -- The subject Space will be a dominant one at the Ohio Science Education Association's Eighth Annual Fall Conference.

The conference, set for Oct. 16 and 17, will be held at the National Aeronautics and Space Administration's Lewis Research Center.

Some 300 elementary, junior and senior high school teachers are expected to attend.

They will be welcomed to Lewis by Dr. W. T. Olson, assistant director.

Following these remarks, Dr. Olson will address the group on "Steps Into Space," in which he will describe, in general, the nation's space program and, in particular, the activities of the Lewis Research Center.

In the afternoon of Oct. 16, some of the teachers will tour the Center's research facilities. Stops are scheduled at the 10 x 10 Supersonic Wind Tunnel; Electric Propulsion, Materials Processing, and Energy Conversion Laboratories, and the Rocket Engine Test Facility.

Another group will visit the laboratories and facilities of the Western Reserve University Medical Center.

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At the association's annual dinner (Oct. 16), the principal speaker will be Donald P. Hearth, Program Manager for Advanced Projects and Technology, NASA Headquarters. He will speak on the "Current and Future Lunar and Planetary Flight Program."

The Oct. 17 conference schedule includes a NASA Spacemobile science lecture-demonstration. The Spacemobile program is designed to give students a clear understanding of space activities through lectures on and demonstrations of scientific principles with space applications. Spacemobiles are visiting schools throughout this country, and in a few foreign nations.

The conference program includes speeches and panel discussions by scientists, educators and industrial executives.

Sessions will be held in the auditoriums of Lewis' Administration and Development Engineering Buildings.

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FOR RELEASE: FRIDAY A.M.'s
OCTOBER 16, 1964

(Released simultaneously in Wash., D.C. and Cleveland, Ohio)

Release 64-93

Lynn Manley
(res: 243-3489)

CLEVELAND, Ohio, Oct. 16 -- Success with the world's first electric rocket engine flight has led research scientists of the National Aeronautics and Space Administration to decide against a second flight test.

The initial SERT I (space electric rocket test) July 20, under direction of NASA's Lewis Research Center, met the prime objective of proving that a stream of ions (highly charged particles) can be neutralized in space. It also demonstrated that the ion stream could produce thrust. Since the flight, scientists have continued ion engine research on the ground.

Ion engines have the advantage of very low propellant consumption and very long operation although the thrust is extremely low. These are great advantages in propulsion for future deep space missions.

The July 20 SERT I flight from NASA's Wallops Station, a significant "first" in the electric thrust program, ended speculation about neutralization. Before the event, it had not been proved conclusively that an ion beam could be neutralized effectively. Without neutralization, there would be no fast-moving stream of particles to provide thrust.

- more -

The SERT I spacecraft was launched by a Scout rocket on a ballistic path to a height of 2550 miles over the Atlantic for a distance of 2100 miles. During the 47-minute flight, the spacecraft was a test bed for two ion thrustors, which were mounted at right angles to the axis of the Scout fourth stage. In operation, one engine would increase the spin of the stage, and other would reduce its RPM.

The information gathered by SERT I has been studied by scientists of NASA's Lewis Research Center, who conducted the experiment for the Office of Advanced Research and Technology.

SERT I carried a contact-ionization engine using cesium propellant and an electron-bombardment engine type using mercury propellant. The first engine was made by Hughes Research Laboratories, the other by NASA's Lewis Research Center.

Scientists noted that the tungsten ionizer in the Hughes engine appeared to be in working order during pre-launch operations and in the boost phase. However, the engine failed to operate after repeated tries over a period of many minutes. Scientists believe the Hughes thrustor would have operated in space if the voltage could have been maintained on the ion source.

The Lewis engine produced an ion beam which developed .0055 pounds of thrust. An increase in the spin rate of the spacecraft was detected by an accelerometer.

The Lewis engine operated for 19 minutes, but experienced automatic shutdowns varying from 2 to 16 seconds. Similar periodic shutdowns are normally encountered in vacuum tank tests for several minutes to a few hours after starting an ion engine. They are caused by electrical breakdowns which become less frequent after the engine has operated for a while.

An instrument probe, used to survey the beam seven inches behind the engine, showed that the beam had expanded by a small amount, the same measure found in vacuum tank tests. This served as additional confirmation of the neutralized ion beam. When the neutralizer was turned off, the ion beam stopped.

A second attempt to start the Hughes engine was tried again without success. The Lewis engine was re-started and continued to operate, with short shutdown periods, for 9 1/2 minutes until the flight reentered the atmosphere.

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FOR RELEASE: IMMEDIATE

Release 64-98

Hugh W. Harris
(res: 681-9354)

CLEVELAND, Ohio, Oct. 22 -- Research in new materials and fabrication methods and the implications it has for industry were outlined by three National Aeronautics and Space Administration engineers this week at a meeting in Michigan.

Austin F. Reader, chief of Fabrication Division at NASA's Lewis Research Center here, Richard H. Kemp, head of Power Plant Structures Section and Dr. Hubert B. Probst, head of Refractory Compounds Section, spoke at the Michigan Industry-University Research Conference at Michigan State University.

Using unmachinable, unweldable, inflexible materials to build components with impossible shapes, finishes and tolerances has become standard practice within the nation's aerospace program according to Reader. "What we have learned in the space program is applicable to the entire fabrication industry," he said.

"High energy rate forming methods, using explosives, spark discharge, vaporizing or electromagnetic means, have advanced rapidly in recent years," he told industry representatives," and require relatively low capital investments."

Kemp told of advances being made in materials for use in temperature ranges from hundreds of degrees below zero to those of conventional turbojet engines. Both the advantages and problems connected with new materials

- more -

were covered. Austenitic stainless steels, aluminum alloys, berryllium and reinforced plastics were discussed for cryogenic and room temperature application. For intermediate temperatures up to approximately 2,000 degrees Fahrenheit advances in nickel and cobalt base alloys were presented.

Materials suitable for use at elevated temperatures ranging from 2,000 to 6,000 degrees Fahrenheit were covered in the talk by Dr. Probst. Recent research programs on fiber metallurgy, refractory metals and refractory compounds were outlined and their results discussed.

Dr. Probst told of Lewis investigations of the two materials with the highest melting points known to man. Tantalum carbide and hafnium carbide both melt in the 7,000 degree Fahrenheit range.

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October 23, 1964

NOTE TO EDITORS:

On October 29 and 30, 1964 the Lewis Research Center will conduct the second in a series of regional conferences aimed at surveying selected areas of aerospace research and development that might be beneficial to other elements of the nation's economy.

The Conference on New Technology will be presented to business, industrial and university representatives of Ohio, Pennsylvania, Michigan, Missouri, Kansas and Indiana. About 350 persons are expected to attend.

The conference was first held on June 4 and 5 of this year. As a result of numerous requests from individuals and companies not present at the initial session, Lewis will repeat the conference on Oct. 29-30.

During the two-day conference, Lewis scientists and enigneers will discuss such areas as fabrication, materials, electric power generation, instrumentation and controls, ion and plasma physics, cryogenics and superconductivity, liquid metals and seals, bearings and lubricants.

During the evening of the first day, conference attendees will hear an address by James E. Webb, NASA Administrator, who will describe NASA's Technology Utilization Program, which was initiated to disseminate aerospace ideas, innovations and techniques to the general economy.

We invite your coverage of this two-day conference which will be held in the Lewis Development Engineering Building, just across Brookpark Road from the center's main entrance. If you have additional questions concerning the meeting, please contact my office.

Lynn Manley
Director of Public Information

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FOR RELEASE: IMMEDIATE

Release 64-99

Hugh W. Harris
(res: 681-9354)

CLEVELAND, Ohio, Oct. 27 -- More than $3.4 million in major contracts were awarded during September by the National Aeronautics and Space Administration's Lewis Research Center here in support of its space research and development programs.

Contracts of $25,000 or more went to companies in seven states. They are listed alphabetically by state and city.

CALIFORNIA:	$42,945
Malibu	Hughes Aircraft Co., $42,945, fabrication and testing of power conditioner system.
KENTUCKY:	$250,000
Paducah	U.S. Atomic Energy Commission, $250,000, injectors for nitrogen tetroxide, liquid hydrogen and liquid oxygen.
MASSACHUSETTS:	$69,133
Cambridge	A. F. Robinson Boiler Works, $41,373, shroud assembly.

- more -

MASSACHUSETTS (Continued)	
Newton Highlands	U.S. Dynamics, Inc., $27,760, recirculating argon purification system.
MICHIGAN:	$29,565
Bay City	Wellman Bronze & Aluminum Co., $29,565, magnesium casting and component parts.
NEW JERSEY:	$83,958
Fairfield	Astrosystems International Inc., $83,958, fuel injectors.
OHIO:	$2,661,608
Cleveland	Honeywell Inc., $25,178, potentiometers, services and materials necessary to modify precision indicators. Roediger Construction Inc., $1,160,000, construction of an addition and the modernization of the Instrument Research Laboratory at the Lewis Research Center.
Fremont	Valley Electric, $28,850, electrical work for safety systems for hydrogen heat transfer facility, Plum Brook Station. Mosser Construction Co., $1,386,000, construction of an Engineering Building at the Plum Brook Station.
Lima	Westinghouse Electric Corp., $61,580, experimental model of a power converter for ion thrustors.
PENNSYLVANIA:	$301,870
Irvine	National Forge Co., $43,500, pushrod.

PENNSYLVANIA (Continued)

Philadelphia	Pennsalt Chemicals Corp., $35,370, vacuum booster and mechanical pumps. General Electric Co., $200,000, magneto gas dynamic power generation study.
West Homestead	Masta Machine Co., $32,000, forged cylinder.

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FOR RELEASE: IMMEDIATE

Release 64-100

Henry T. Jacques
(res: 251-1047)

CLEVELAND, Ohio, Oct. 28 -- Two contracts have been awarded recently for construction of facilities at the National Aeronautics and Space Administration's Lewis Research Center here and its Plum Brook Station in Sandusky, Ohio.

One contract -- awarded to Roediger Construction, Inc., Cleveland -- is for construction of an addition to Lewis' Instrument Research Laboratory. The contract, valued at $1,160,000, also covers modernization of the existing lab building.

The Mosser Construction Co. of Fremont, Ohio, will build an Engineering Building at the Plum Brook Station under a $1,386,000 contract.

The addition to the Instrument Research Laboratory at the center will be a three-story structure with dimensions of 110 by 110 feet. It will provide space for 41 labs and 20 offices. The main moderinization work will be on the air-conditioning system of the present lab.

The contract completion date is October 1965.

The Plum Brook Engineering Building will have 55,000 square feet of floor space. It will consist of a two-story, L-shaped structure, 230 by 215 feet, and a one-story wing, 120 by 130 feet.

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The two-story section will house offices for 300 persons and conference rooms.

In the wing will be a cafeteria and an assembly room. The cafeteria will have a seating capacity of 250 persons; the assembly room, 500. The assembly room is a multi-purpose area which can be subdivided by folding doors into three equal-sized rooms for smaller technical meetings, classes, and other uses.

The contract includes parking lots for 300 cars, installation of utilities, roads, and landscaping. Completion date is set for September 1965.

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FOR RELEASE: IMMEDIATE

Release 64-102

Joann T. Temple
(res: 941-4769)

CLEVELAND, Ohio, Nov. 6 -- An analytical method used by archaeologists and homicide detectives has been put to work for the U.S. space program and may soon benefit manufacturers of high-purity alloys, according to development engineers at the National Aeronautics and Space Administration's Lewis Research Center here.

The method -- called neutron activation analysis -- is an accurate, fast and non-destructive way to find out what anything is made of. The object or specimen to be examined is exposed to radiation. The chemical elements in the object respond to radiation by releasing waves of measurable energy. Each of these waves is characteristic of a specific chemical element. The amount of energy is characteristic of the amount of each element in the object.

Thus, a total chemical picture, as distinctive as a fingerprint, can be obtained of any item -- a clay dish 10 centuries old, a strand of hair clutched in a murder victim's hand, or a sample of potassium metal destined for space research.

Activation analysis pinpoints the age of archaeological relics by determining the amount and type of carbon present. It has been admitted as court evidence and served to convict at least one murder suspect in Canada. It has even been used to lend strength to the historical suggestion that Napoleon was murdered. A recent activation analysis on a strand of Napoleon's hair found almost fifteen times the healthy arsenic content.

- more -

In the space program, activation analysis can now pinpoint as few as three oxygen molecules hidden among a million potassium molecules. This could be extremely important because potassium and other alkali metals which are liquid within a few hundred degrees of room temperature are slated to play an important role in future spacecraft needing megawatt electric powerplants onboard.

The excellent heat transfer properties of liquid metals make them superior working fluids for such space power systems. Liquid metals can run much hotter than the water used in earthbound powerplants. With this higher temperature comes increased efficiency and smaller size, especially in the radiator.

The corroding effects of liquid metals depend to a large degree on the oxygen content of these metals. Thus, space power systems engineers were looking for an accurate way to determine the oxygen content of potassium. This was complicated by potassium's propensity to pick up oxygen when exposed to air.

The General Atomics Division of General Dynamics Corporation undertook this oxygen-identification problem in alkali metals under a contract from the Lewis Research Center. Using their activation analysis system, they report that "Oxygen determinations can now be made faster, more precisely, non-destructively, and with better sensitivity, with almost an order of magnitude improvement in precision and sensitivity, than was possible a year ago. The cost per analysis is competitive with all other oxygen methods in use today."

This system uses copper or tantalum capsules to hold the potassium sample and keep it from oxygen contamination. Neutron radiation, produced by bombarding a tritium target with deutrons, bombards the sample and changes any oxygen present to nitrogen-16, an isotope of nitrogen which emits measurable waves of gamma radiation.

The samples are then transferred to a multi-channel gamma-ray spectrometer where the radiation emitted from the sample is filtered through two sodium iodide crystals to cut down smearing of the gamma-ray spectra by beta rays, also emitted by nitrogen-16. A gamma-ray spectra is then obtained and the photopeak counts are related back to a standard sample.

Under favorable conditions, transfer can be done in half a second. The counts are then analyzed to determine the original oxygen content. As the oxygen in the capsule is known quite accurately, any excess oxygen must belong to the sample metal. With a half-second transfer time, this excess can be pinpointed with an accuracy of three parts per million.

General Atomics reports that manufacturers of high-purity steels and alloys are interested in such rapid, accurate oxygen determinations. A number of steel companies are investigating the possibility of using this new oxygen determination system.

Oxygen in steel plays a decisive role in the strength, ductility and durability of the product.

Small amounts of oxygen also play very important parts in the utility of other metals such as copper, aluminum, zinc and silver.

This activation analysis method provides a better determination than was previously available and its use in industry will be explored.

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FOR RELEASE: IMMEDIATE

Release 64-104

Henry T. Jacques
(res: 251-1047)

CLEVELAND, Ohio, Nov. 13 -- Suggestions for improved designs and devices resulting in more efficient and economic methods won awards recently for eight employees of the National Aeronautics and Space Administration's Lewis Research Center.

Ideas that gained cash awards and commendations for the employees included the use of styrofoam balls as an insulating blanket for open top tanks, a new burner head, and a replaceable plug for test holes in the Center's 8 x 6 Wind Tunnel.

The suggestions will result in tangible savings of nearly $10,000 per year and many intangible benefits to the Government.

The cash awards, based on benefits and made under provisions of the Government Incentive Awards Act, ranged as high as $150.

Five of the award winners are employed at the main facility in Cleveland. Three work at Lewis' Plum Brook Station near Sandusky, Ohio.

Ralph A. Jacko, Facilities Services Division, Plum Brook Station, designed a new burner head for work with FLOX (a liquid oxygen-liquid fluorine mixture).

- more -

His design resulted in a sharp reduction in downtime for burner repairs and burnoff operations at one of the Station's research sites. He was awarded $150.

Robert Kaczmarek, Test Installations Division, Lewis, also won a $150 award.

He suggested a simplified design for a resistance-type heater element for use in a vacuum furnace. The new design makes the elements more durable.

Emil Napholz, Facilities Services Division, Plum Brook, won a $140 award.

His idea was to float styrofoam balls on liquid nitrogen during research operations in which the cryogenic (extremely cold) nitrogen must be stored in open top tanks.

The balls act as an insulating blanket and prevent the nitrogen from being boiled away by contact with air.

George Yurescko, Test Installations Division, Lewis, was awarded $110 for suggesting a replaceable plug for test section holes in the 8 x 6 Wind Tunnel.

His plugs make for a more durable aerodynamic surface in the test section and reduce the downtime needed for test section hole configuration changes.

Frank Rudin, also Test Installations Division, won $85 by suggesting installation of a visual monitor and a filter in mercury condensing loops.

The filter saves time and eliminates possible system contamination. The monitor allows constant checks to be made of conditions in the closed loop system.

Robert DeFayette, Reactor Division, Plum Brook, suggested that bulbs without tungsten be used in the nuclear reactor tank.

Accidental breakage and burnout of the underwater lights caused operational problems when the tungsten was released. DeFayette received a $50 award.

Raymond E. Schuerger, Test Installations, Lewis, is $25 richer for his suggestion.

It concerned location of a sodium test rig ventilation system. He proposed locating the filter unit in a more accessible section of metal ducting and reduced time needed to change the filters.

Herbert L. Smith, Test Installations, devised a mechanism which allows a more positive electrical connection to heaters on removable sections of tubing.

He received $25 because his quick-disconnect socket assembly reduces downtime for removing, cleaning, and reinstalling pipe sections to which heaters are attached.

Home addresses of the winners are:

Robert DeFayette	1232 Marlboro Avenue	Sandusky, Ohio
Ralph A. Jacko	2215 Mark Drive	Lorain, Ohio
Robert Kaczmarek	4352 W. 182 Street	Cleveland, Ohio 44135
Emil Napholz	1128 McKinley Street	Sandusky, Ohio
Frank Rudin	15848 Rademaker Blvd.	Cleveland, Ohio 44142
Raymond E. Schuerger	Reed Road R. F. D #1	Columbia Station, Ohio
Herbert L. Smith	486 Crescent Drive	Berea, Ohio
George Yurescko	1318 W. 106 Street	Cleveland, Ohio 44102

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FOR RELEASE: IMMEDIATE

Release 64-105

Joann T. Temple
(res: 941-4769)

CLEVELAND, Ohio, Nov. 13 -- A gas bearing, designed as a research tool, is being tested in a vacuum simulating the space environment at an altitude of more than 100 miles here at the National Aeronautics and Space Administration's Lewis Research Center.

Robert R. Lovell, project engineer, explains that the bearing was planned as part of the Lewis Research Center's philosophy of intensive preflight testing of all space systems.

Suspended from the top of a 60-foot-long, 15-foot diameter tank, the bearing provides complete freedom of motion to any payload attached to the bearing. A suspended payload has three-axis mobility with a 10 degree swing in both pitch and yaw.

Designed to carry an average 350-pound payload, the bearing has already been checked out with more than its 500-pound maximum on it. With no spin applied to the bearing and its payload, the observed turbine torque produced by the air bearing is less than that estimated in space.

Only a small amount of rocket thrust is necessary to keep a communications satellite pinpointed on its station above the earth. An equally small thrust can overcome the slight aerodynamic drag a large space station would necessarily encounter in orbit.

- more -

Such low-thrust systems could be easily tested in vacuum tanks if there were a way to suspend the test systems. This new bearing, capable of vacuum operation, solves the problem. Proposed systems for attitude control or station-keeping can now be fully evaluated in on-the-ground tests.

The first payload tested will probably be a subliming rocket attitude control system. This has only millipounds of thrust.

Cold gas jets and various electrostatic engine systems will also be tested. A hydrolysis attitude control system using water as a fuel is slated to be flight-checked on the Lewis bearing. Using solar power in space, this system hydrolyzes water into oxygen and hydrogen gas to be recombined and expelled from nozzles.

Lovell explains that the bearing, encased in a large housing, floats on a film of carbon dioxide that varies from 5 to 8 ten-thousandths of an inch in thickness. This carbon dioxide is fed through 12 inlets while a scavange groove near the center shaft entrance draws off most of the supply gas. With a small carbon dioxide leakage in the vacuum tank, space conditions can still be simulated.

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FOR RELEASE: IMMEDIATE

Release 64-106

Henry T. Jacques
(res: 251-1047)

SANDUSKY, Ohio, Nov. 19 -- Construction is underway on a building for the assembly, testing, and storage of experiments slated for irradiation in the NASA Plum Brook Reactor Facility here.

The construction firm of Jennings and Churella, New London, Ohio, is doing the work under a $539,000 contract.

The new reactor complex building -- a two-story structure with 23,000 square feet of work area -- will provide the space needed for assembly and pre-irradiation testing of larger experiments. Room will be provided also for assembly shops and instrument calibration and electronic testing areas.

The building will house a 172,000-gallon pool for pre-irradiation testing of experiments in an underwater environment similar to that required for reactor operations.

The structure will be connected by a wing to an office building and by an underground tunnel to the main reactor building. The tunnel will be used for both routing and storage of experiments.

Completion of the project is expected by September 1965.

The Plum Brook Reactor is being used for studies in basic research associated with NASA's plans to develop a nuclear rocket for future interplanetary exploration, and the development of components and systems for space nuclear auxiliary and main propulsive power.

Work at the Plum Brook Station is under the direction of NASA's Lewis Research Center, Cleveland, Ohio

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FOR RELEASE: IMMEDIATE

Release 64-107

Hugh Harris
(res: 681-9354)

CLEVELAND, Ohio, Nov. 20 -- More than $1.9 million in major contracts were awarded during October by the National Aeronautics and Space Administration's Lewis Research Center here in support of its space research and development programs.

Contracts of $25,000 or more went to companies in five states and the District of Columbia. They are listed alphabetically by state and city.

CALIFORNIA:	$565,507
Malibu	Hughes Aircraft Company, $429,710, program of fabrication and life testing of liquid Hg cathodes in an operating electron-bombardment ion thrustor.
Santa Fe Springs	Ace Industries, $34,900, four stater ring assemblies and spare blades.
Stanford	Stanford University, $100,897, plasma diagnostic study.
DISTRICT OF COLUMBIA:	$319,094
	Atomic Energy Commission, $235,000, development of methods of producing ultra-high purity uranium dioxide particles, and chemically analyzing for trace impurities in tungsten-urania composites. Cosmic, Inc., $84,094, analytical and experimental program for further development of a charged liquid colloid source.

- more -

ILLINOIS:	$45,553
Springfield	Sangamo Electric Co., $45,553, magnetic tape recording system.
NEW YORK:	$98,500
Flushing	Warner & Swasey, $50,000, experimental and theoretical study of infrared combustion gas analysis.
New York	Union Carbide Corp., $48,500, boron nitride parts
OHIO:	$855,000
Cleveland	Acme Construction, $25,075, service, labor and material to construct a railroad spur track at the Plum Brook Station. Clevite Corp., $97,803, program to develop cadmium-sulfide thin film photovoltaic cells.
Columbus	Elsberry Contractor, $67,122, service, labor and material for the installation of piping and equipment for the hydrogen heat transfer facility at Plum Brook Station.
North Royalton	Central Contractors, $126,000, alterations to test cell in the Engine Research Building.
New London	Jennings & Churella, $539,000, construction of the assembly, test and storage building.
PENNSYLVANIA:	$44,350
West Homestead	Mesta Machine Co., $44,350, 24-inch diameter ball valve.

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FOR RELEASE: IMMEDIATE

Release 64-108

Henry T. Jacques
(res: 251-1047)

CLEVELAND, Ohio, Nov. 27 -- Robert G. Deissler, Chief of the Fundamental Heat Transfer Branch at the National Aeronautics and Space Administration's Lewis Research Center here, has been selected to receive the Heat Transfer Division Memorial Award of the American Society of Mechanical Engineers.

The presentation will be made by Dr. E. O. Bergman, society president, at the Winter Annual Meeting of the ASME's Heat Transfer Division in New York City on Dec. 1.

The memorial award, consisting of a citation, was established by the Division in memory of distinguished colleagues and serves as the principle means of recognition that the Division can award.

Deissler is being honored for his contributions to the science of turbulent flow heat transfer.

He has specialized in heat transfer and fluid mechanics research since joining the Lewis staff in 1947. He has authored 40 technical papers in those fields.

Deissler was awarded the Exceptional Service Medal of the National Advisory Committee for Aeronautics, NASA's predecessor, in 1957.

- more -

A native of Greenville, Pa., he received a bachelor of science degree in mechanical engineering from Carnegie Institute of Technology in 1943 and a master of science degree from Case Institute of Technology in 1948.

Deissler is a member of the ASME and has served on its Aircraft and Astronautical Heat Transfer Committee. He also holds membership in the American Institute of Aeronautics and Astronautics and the American Physical Society.

He and his wife, June, live at 4540 W. 213th Street, Fairview Park. They are the parents of four children.

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FOR RELEASE: IMMEDIATE

Release 64-109

Henry T. Jacques
(res: 251-1047)

CLEVELAND, Ohio, Dec. 1 -- Three staff members of the National Aeronautics and Space Administration's Lewis Research Center recently received awards for inventions.

Morris Perlmutter and John R. Howell, both of Lewis' Fundamental Heat Transfer Branch, shared a $300 award for their invention of a device for directionally controlling electromagnetic radiation.

Robert Steinberg, Reactor Physics Branch, was awarded $100 for a molecular beam velocity selector.

With the Perlmutter-Howell device, it is possible to emit electromagnetic radiation in a narrow beam in a desired direction or to absorb only radiation coming in from a desired direction. A possible application of the device is in thermoelectric cells in space.

Steinberg designed a molecular beam velocity selector with a resolution which is an order of magnitude higher than the resolutions possible with previous units. It will be useful in rarefied gas dynamics research.

The awards were made under the Government Incentive Awards Act.

Home addresses of the recipients are:

Howell	15 Cadet Drive	North Ridgeville, Ohio
Perlmutter	3204 W. 98th Street	Cleveland, Ohio
Steinberg	748 Carteret Court	Berea, Ohio

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FOR RELEASE: WEDNESDAY P.M.'S
DECEMBER 2, 1964

Release 64-111

Joann T. Temple
(res: 941-4769)

CLEVELAND, Ohio, Dec. 2 -- Project officials at the National Aeronautics and Space Administration's Lewis Research Center report a significant milestone in the development of the SNAP-8 space power generation system.

SNAP-8 (system for nuclear auxiliary power), designed to supply electric power on-board a spacecraft, uses nuclear heat to produce 35 kilowatts of power. The system is under development for NASA by Aerojet-General Corporation's Von Karman Center, Azusa, California.

Henry O. Slone, SNAP-8 project manager at Lewis, reported a successful 76 hour test of SNAP-8's turbine alternator assembly (TAA) using Mercury as the working fluid. "This test demonstrated operational capability, and machine performance up to 80% of its rated power," Slone said.

Rated power and endurance tests on the TAA are planned for the near future. Slone said, "We are pleased with the results of this significant test and also the results of previous tests performed on the mercury pump motor assembly, lubricant/coolant pump motor assembly, condenser, and electrical controls."

When fully developed, SNAP-8 will have the capability to operate unattended in space for 10,000 hours -- about 14 months.

SNAP-8, the first development attempt to exploit the unique properties of metals which are liquid within a few hundred degrees of room temperature, is exploring the possibility of adapting liquid metals to power-producing thermodynamic cycles for possible use in large manned space stations, lunar bases and deep space probes of the future.

- more -

Liquid metals, such as Mercury and Potassium, have extremely stable molecular structures and excellent heat transfer capabilities. Their large liquid range makes them useful over a wide variety of applications.

Liquid metals can run much hotter than the water used in earth-bound powerplants. With this higher heat comes increased efficiency and smaller size, especially in the space radiator.

SNAP-8 uses Mercury and NaK, a eutectic mixture of Sodium and Potassium. The NaK, cycled through the nuclear reactor is heated to about 1300° F. before it enters a heat-exchange apparatus. Here it heats liquid Mercury to a vapor that is expanded through a work-producing turbine at 1250°F. This turbine powers an electric generator in much the same way that earthbound powerplants use steam to drive a turbine.

It was this turbine alternator assembly that completed its first significant test last week.

The heat source for the turbine alternator test was a gas-fired heater, not a nuclear reactor which ultimately will provide the energy source for SNAP-8. The nuclear reactor for SNAP-8 is being developed by Atomics International under contract with the Atomic Energy Commission. This component testing is scheduled for completion next year.

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FOR RELEASE: IMMEDIATE

3 P.M.

Release 64-113

Hugh W. Harris
(res: 681-9354)

CLEVELAND, Ohio, Dec. 8 -- A $2,315,400 contract for design, development and testing of an Atlas launch vehicle sustainer engine to use FLOX (liquid fluorine, liquid oxygen) has been awarded by the National Aeronautics and Space Administration's Lewis Research Center to North American Aviation's Rocketdyne Division in Canoga Park, California.

The contract provides for firing a complete Atlas sustainer engine for the first time using FLOX as the oxidizer. RP-1, a type of kerosene will still be used as the fuel. Prior to the engine firings, a series of gas generator and gas generator turbopump tests will be conducted.

Under previous contracts, components of both the Atlas engine and vehicle have been tested for compatibility with FLOX mixtures. Some components have been redesigned or made from different materials for use with FLOX.

Scientists and engineers have been interested in learning more about using fluorine for many years. An extremely active element, fluorine releases more energy when burned than liquid oxygen. This increased energy would allow the same amount of propellant to launch heavier payloads or complete the same mission with less propellant.

- more -

Because it is so extremely reactive, fluorine is a difficult element to handle. Many of the serious problems with it have been solved during the more than 15 years of fluorine study both at Lewis and by several industrial organizations. Some of the remaining problems are lessened by combining it with liquid oxygen. The FLOX mixture now under consideration uses 30 per cent liquid fluorine and 70 per cent liquid oxygen.

FLOX Project Manager for Lewis is Howard W. Douglass.

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FOR RELEASE: IMMEDIATE

Release 64-114

Hugh W. Harris
(res: 681-9354)

CLEVELAND, Ohio, Dec. 8 -- Three contracts worth more than $1.5 million have been awarded by the National Aeronautics and Space Administration's Lewis Research Center to the Hughes Aircraft Company of Malibu, California for research and development testing of ion engines for space propulsion.

An ion engine produces rocket thrust by creating and accelerating positively charged particles or ions of propellant to velocities of more than 100,000 miles per hour. The thrust from these engines is small but the exhaust velocity is much greater than conventional chemical rockets. Ion engines can operate only in the vacuum of space and may someday be used for interplanetary travel.

The first contract totaling $1, 151, 370 is a twelve-month continuation of a previous contract for research and development of a contact ion engine using cesium as a propellant. The ultimate objective of the program is to design a thrustor capable of 10,000 hours of continuous operation. The program provides for basic hardware improvements in the engine components, thrust studies and an analytical investigation of the feasibility of developing a 100 kilowatt engine system sometime in the future.

The other two contracts are also follow-on efforts. One for $202,915 provides for fabrication of porous alloy and solid sintered ionizers. The other amounting to $243,061 covers tests and evaluation of physical, electrical and cesium ionization properties of porous ionizers and evaluation of the electrical properties of solid sintered ionizer material.

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FOR RELEASE: IMMEDIATE

Release 64-116

Hugh W. Harris
(681-9354)

CLEVELAND, Ohio, Dec. 18 -- More than $7.5 million in major contracts were awarded during November by the National Aeronautics and Space Administration's Lewis Research Center here in support of its space research and development programs.

Contracts of $25,000 or more went to companies in 13 states. They are listed alphabetically by state and city.

CALIFORNIA:	$1,973,644
Malibu	Hughes Aircraft, $76,727, measurement of sputtering yields and energy transfer efficiencies of liquid metals. Hughes Aircraft, $202,915, alloy ionizer fabrication. Hughes Aircraft, $1,151,370, ion engine development. Hughes Aircraft, $243,061, porous ionizer evaluation.
Pasadena	Electro-Optical Systems, $39,621, solar cell sub-assemblies.
Santa Ana	Giannini Scientific Corp., $180,000, design and development of thermoionic electric thrustor.
Van Nuys	Marquardt Corp., $79,950, concentric tube resistojet thrustors.

- more -

COLORADO:	$40,000
Boulder	U. S. Dept. of Commerce, $40,000, to provide technical efforts for the performance of a research and development program on "Superconducting Thin Films".
MASSACHUSETTS:	$138,460
Brockton	Technology Engineering, $73,400, nozzle exhaust duct, duct moist mechanism and nozzle.
Newton	NRC Metals Division, $28,946, alloy sheet, strip, foil and rod and tube hollows T-222, tantalum base.
Waltham	Jerrell-Ash Co., $36,114, air emission spectrometer.
MINNESOTA:	$141,380
St. Paul	Minnesota Mining & Manufacturing Co., $141,380, (classified).
MISSOURI:	$118,545
St. Louis	McDonnell Aircraft Corp., $118,545, study of arcjet propulsion devices.
NEW JERSEY:	$395,000
West Long Branch	Electronic Assoc., Inc., $395,000, two precision analog computing systems.
NEW YORK:	$64,700
Westbury	General Appliance Science Lab., $64,700, real time spectrum analyzer.
NORTH CAROLINA:	$37,000
Durham	Wilmore Electronics Co., Inc., $37,000, improved techniques for power conditioning for ion thrustor application.

- more -

OHIO:	$1,206,262
Cincinnati	University of Cincinnati, $209,520, investigation of heat transfer and instability in two phase flow phenomena. Scocos Plumbing & Heating, $31,661, remove and install fuel and exidant tanks in Test Chamber, PSL Building. Case Institute of Technology, $25,110, training of government employees at Case Institute of Technology. Westinghouse Electric, $34,973, axial flow pump.
Lima	Westinghouse Electric, $904,998, development and evaluation of magnetic and electrical materials capable of operating in the temperature range from 800° F to 1600° F.
PENNSYLVANIA:	$783,233
Callery	MSA Research, $28,750, metal potassium.
Hatboro	Weston Instruments, $40,711, electro hydraulic actuators and fail safe manifolds.
King of Prussia	SKF Industries, Inc., $264,850, supersonic transport lubrication system investigation.
Philadelphia	General Electric, $255,343, study of parametric performance of a two-stage repetitively pulsed coaxial plasma engine. General Electric, $148,579, investigation of a circularly polarized 500w-5000w band plasma accelerator.
WEST VIRGINIA:	$51,000
Huntington	Midvale Mine Co., $51,000, coal stoker.
Joint Contract -	$2,814,924
NEBRASKA , Omaha TEXAS, El Paso	Peter Kiewit Sons Co; C. H. Leavell & Co., Construction of buildings, foundations, underground concrete, mechanical services, paving, grading, railroads and landscaping for Spacecraft Propulsion Research Facility at the Plum Brook Station.

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CRYOGENICS AND SUPERCONDUCTIVITY

Reducing a city's electric power sub-station to the size of a small office is just one of many possible extrapolations of the National Aeronautics and Space Administration's current research on cryogenic and superconducting devices.

These devices are made of materials that lose virtually all electrical resistance at temperatures near absolute zero. Edmund E. Callaghan, Assistant Chief of Lewis' Electromagnetic propulsion Division, cites an experimental superconducting closed ring, immersed in liquid helium at 452° F. below zero that has carried a continuous electric current for several years with no measurable decrease in the current. Thus, in this case of a true superconductor, the resistance can certainly be considered zero.

Mr. Callaghan pointed out that using superconductors in electrical devices could substantially reduce their size and, perhaps more important, their power consumption. To be desirable, the power savings would, of course, have to include the power needed for refrigeration to keep the device at super-cold cryogenic temperatures.

Good conductors such as copper or aluminum, show a decrease of 10,000 to 100,000 in resistance between room temperature and absolute zero. But, such common conductors are not usually very good superconductors if they have any superconducting properties at all. True superconductors show a very sharp drop in resistance at very low temperatures. Lead and tin are two such materials.

Superconductivity is explained physically by the drastic decrease in temperature reducing the internal activity in the atoms of the material. This reduced activity allows electrons to pass more easily through the lattice structure--thus, the material presents less resistance to electricity, the flow of electrons, and becomes superconducting.

- more -

Another property of superconductors is that magnetic field lines are totally excluded. Mr. Callaghan demonstrates this with a lead dish chilled in liquid helium until it becomes superconducting. In this state, the magnetic field lines of any other body are totally excluded from the dish. Thus, a small bar magnet will "float" above the dish apparently hanging in mid-air but actually floating on its own magnetic field.

One possible future application of this phenomenon could be a superconducting bearing where a shaft would float on a magnetic field. Such a bearing would truly be frictionless.

Since the highest temperature at which any known material is superconducting 427^{O} F. below zero, all superconducting devices require liquid helium as a coolant. However, Mr. Callaghan notes that it is possible to use cryogenic but non-superconducting techniques to substantially reduce the total power consumption of many electricl systems.

A magnet to produce a magnetic field of 100,000 gauss (200,000 times stronger than the magnetic field of the Earth) would absorb 3000 kilowatts of electrical power if operated at room temperature. A cryo-magnet to do the same job would need only 120 kilowatts and a superconducting magnet would need none.

Although immediate applications of super-magnets may well be limited to the space industry, Mr. Callaghan says that many conventional devices, even such prosaic and well developed items as transformers, can be significantly improved by using superconducting materials. Electric power savings could be substantial and such systems would be greatly reduced in size, by factors of 10 to 100.

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PHONE - (AREA CODE 216) 433-4000 EXT. 415

FOR RELEASE: IMMEDIATE

Release 65-2

Hugh W. Harris
(res: 681-9354)

CLEVELAND, Ohio, Jan. 6 -- The National Aeronautics and Space Administration will negotiate a contract with the Lockheed Missiles and Space Company Division of Lockheed Aircraft Corp., Sunnyvale, Calif., to modify five Agena D second-stage launch vehicles for use in Lunar Orbiter missions.

The incentive contract is expected to amount to about $6 million.

The Agena D stage will be mated to an Atlas booster and to the Lunar Orbiter spacecraft for each of the five planned NASA missions.

Agena D modifications peculiar to the Lunar Orbiter requirements will include vehicle engineering support; systems testing; overall system integration functions; shroud, adapter and interface coordination; and design fabrication of the ground equipment.

Lockheed designed and developed the original Agena vehicle. The first was launched in 1959. NASA's Lewis Research Center here has management responsibility for Thor/Agena and Atlas/Agena launch vehicle systems. These vehicles support the Ranger, Mariner, Nimbus, Comsat, ISIS, Lunar Orbiter, OAO programs. Lewis responsibility starts with defining the launch vehicle requirements and follows through the design, fabrication, test, launch preparations and launch up to injection of the spacecraft into the proper trajectory.

- more -

The television camera equipped Lunar Orbiter spacecraft will support both the manned lunar landing and Surveyor spacecraft programs. It will be sent into an initial 575 mile high orbit around the moon. The craft will remain in this orbit long enough to make final course corrections and transmit a series of pictures back to earth. The craft will then be sent into an elliptical orbit swinging down to within 22 miles of the moon's surface to take a series of sharply defined pictures of likely landing spots for Surveyor and manned spacecraft.

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FOR RELEASE: IMMEDIATE

Release 65-3

Hugh W. Harris
(res:681-9354)

CLEVELAND, Ohio, Jan. 7 -- A $5,178,000 contract for a 100 by 122-foot aluminum test chamber which will form the heart of the new Space Propulsion Facility has been awarded by the National Aeronautics and Space Administration's Lewis Research Center.

The contract was awarded to a joint venture consisting of Blount Brothers Corp. of Montgomery, Alabama and Chicago Bridge and Iron Co. of Oak Park, Illinois.

Being constructed at Lewis' Plum Brook Station near Sandusky, Ohio, the facility will be one of the world's largest space environment chambers. The cylindrical test chamber will be 100 feet in diameter and 122 feet to the top of its hemispherical dome. Approximately 2,000,000 pounds of aluminum will be used to form the shell and its two 50-foot square doors.

The facility will be used for evaluation and developmental testing of complete spacecraft, as well as nuclear electric power generation and propulsion systems. Problems that may occur in space during start-up, power setting changes, long-term operation and shutdown will be studied.

Surrounding the aluminum test chamber will be a reinforced concrete enclosure. The enclosure walls will be six feet thick by 150 feet tall and include an air-tight steel membrane. The two portals will be closed by concrete doors moved into position by hydraulic actuators.

- more -

Attached to the space environment chamber will be an office building, control building and disassembly building. A vacuum equipment building, refrigeration building and shop will also be included in the structure.

Basic construction contracts have already been awarded.

Harold E. Friedman, project engineer, said the facility is scheduled for completion early 1967.

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FOR RELEASE: IMMEDIATE

Release 65-6

Hugh W. Harris
(res: 581-9354)

CLEVELAND, Ohio, Jan. 15 -- More than $8.8 million in major contracts were awarded during December by the National Aeronautics and Space Administration's Lewis Research Center here in support of its space research and development programs.

Contracts of $25,000 or more went to companies in 12 states. They are listed alphabetically by state and city.

ARIZONA:	$74,000
Phoenix	Garrett Corp., $74,000, program to determine the performance characteristics of a Brayton cycle radial compressor.
CALIFORNIA:	$2,667,836
Canoga Park	Rocketdyne Division of North American Aviation, Inc., $2,315,400, design, development and testing of Atlas MA-5 sustainer engine with FLOX.
Malibu	Hughes Aircraft Co., $118,901, ion thrustor electrode surface physics studies.
Pasadena	Electro Optical Systems, Inc., $35,000, tungsten-10% tantalum porous ionizer slabs. Machine Dynamics, Inc., $32,285, hydraulic vibration system.

- more -

CALIFORNIA (Continued)	
Redondo Beach	Thompson Ramo Wooldridge, Inc., $96,450, research on ion beam diagnostics.
San Diego	General Dynamics Corp., $69,800, storage, preservation, maintenance and inspection of four (4) Mercury-type Atlas series "D" boosters.
CONNECTICUT:	$141,660
Middletown	Pratt & Whitney Aircraft Division of United Aircraft Corp., $141,660, investigation of cavitation damage of an existing mechanical pump impeller operating in an existing high-temperature potassium test facility.
FLORIDA:	$82,093
Ft. Lauderdale	Systems Engineering Lab, Inc., $82,093, digital data system.
MICHIGAN:	$26,482
Warren	General Motors Corp., $26,482, program to develop a new plasma diagnostic technique
NEW JERSEY:	$130,410
Princeton	Radio Corporation of America, $130,410, thin-film photovoltaic solar energy converters.
NEW YORK:	$147,798
Schenectady	General Electric Co., $147,798, development of high temperature, gas filled ceramic rectifiers, thyratrons, and voltage reference tubes.
OHIO:	$418,711
Cincinnati	General Electric Co., $281,348, development of electrical switchgear for space nuclear electrical systems.

Cleveland	Honeywell Inc., $36,375, potentiometers, services and materials necessary to modify Honeywell Inc., precision indicators. Harshaw Chemical Co., $75,003, a program to develop optical coatings for cadmium sulfide thin-film solar cells.
Columbus	Ellsberry Contractors, Inc., $25,985, removal and replacement of liquid hydrogen valve at "F" Site, Plum Brook Station, Sandusky, Ohio.
Joint Contract -	$5,178,000
ALABAMA, Montgomery ILLINOIS, Oak Park	Blount Brothers Corporation; Chicago Bridge and Iron Co., services, labor and material for construction of an Aluminum Test Chamber, Plum Brook Station, Sandusky, Ohio.

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FOR RELEASE: IMMEDIATE

Release 65-7

Joann T. Temple
(res: 681-9354)

CLEVELAND, Ohio, Jan. 22 -- When you think of the infinite stretches of interstellar space, the title of a technical paper, "Collisionless Flow of an Ionized Gas through a Channel with an Imposed Magnetic Field," probably doesn't immediately come to mind.

But this paper is a new tool in understanding rarified plasmas such as are found in space. Prepared by Morris Perlmutter of the National Aeronautics and Space Administration's Lewis Research Center, the paper describes the basic research in the plasma field.

Perlmutter is one of seven Lewis scientists scheduled to participate in the Second Aerospace Sciences Meeting of the American Institute of Aeronautics and Astronautics beginning in New York Monday, January 25.

Perlmutter says, "The paper is actually the report of a step toward understanding the flow of all types of plasmas, including those in which collisions are taking place." This understanding would have broad implications and be applicable to dozens of areas including thermonuclear devices which would harness the almost unlimited power employed in the hydrogen bomb. It would also be applicable to design of electric rocket engines and magneto-hydrodynamic electric generating devices.

This is a new method of using integral equations for solving rarified plasma problems.

Also underdiscussion at the AIAA meeting will be Lewis' work in many fields -- a new class of interplanetary trajectories for manned Mars exploration;

- more -

the possible effects of meteoroid dust on solar reflectors; a review of data from Lewis' SERT-I flight last July which marked the first successful operation of an ion engine in space; and recent studies of composite solid rocket propellants.

The Lewis Research Center is slated for participation in six of eleven general topics at the three-day meeting.

In "Combustion and Propellants," Richard S. Brokaw, Chief, Physical Chemistry Branch, will chair a six-paper session on Wednesday, January 27.

Louis A. Povinelli will describe a spectral radiation-shadowgraph technique for studying composite solid-propellant flame structure.

In "Astrodynamics," Edward A. Willis, Jr., analyzes "efficient, high-thrust" Martian trajectories for round trips ranging from 300 to 1000 days with a range of on-Mars-exploration times from 40 to 450 days.

In the "Ion Propulsion" session, Ronald J. Cybulski, Head, Attitude Thrustor Section, compares the environmental effects of neutralizer beams of electrons on both laboratory and in-flight models of ion engines and discusses furthur possible methods for diagnosis of ion engine performance.

Perlmutter's paper is slated for a "Plasmadynamics" session and, in "Thermophysics," Herman Mark, Head, Aerospace Environment Branch, describes a Lewis-developed laboratory procedure for reproducing the tiny clouds of energetic space dust that may erode or pit reflecting surfaces such as solar collectors. Dr. Mark describes the work done by himself and his co-authors, Ralph D. Sommers and Michael J. Mirtich, in bombarding several target materials with this simulated dust.

The bombarded samples were then placed in Lewis' 10-by-6-foot ultra-high vacuum space simulator to determine the effect of erosion on the equilibrium temperature which the solar collector would assume in space.

In "Fluid Dynamics," Dudley G. McConnell describes his analysis of the heat transfer to and subsequent flow of a melt layer around a glass-like sphere that is decellerating in a manner similar to reentry into a planetary atmosphere.

The broad range of the Clevelanders' subjects reflects the variety of work at Lewis, NASA's second largest center and the space agency's headquarters for research and development of advanced propulsion and power generation systems.

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FOR RELEASE: IMMEDIATE

Release 65-13

Hugh W. Harris
(res: 681-9354)

CLEVELAND, Ohio, Feb. 18 -- More than $5.5 million in major contracts were awarded during January by the National Aeronautics and Space Administration's Lewis Research Center here in support of its space research and development programs.

Contracts of $25,000 or more went to companies in seven states and the District of Columbia. They are listed alphabetically by state and city.

CALIFORNIA:	$777,786
Canoga Park	North American Aviation, Inc., $43,494, (Classified Contract).
Gardena	Data Sensors, Inc., $27,259, strain gage pressure transducers.
San Diego	General Dynamics Corp., $707,033, studies of thermionic materials for space power applications.
DISTRICT OF COLUMBIA:	$38,268
	Harris Research Laboratories, Inc., $38,268, studies of effect of contaminants on interfacial surface energies.

- more -

ILLINOIS:	$30,537
Melrose	Radiation Instrument, $30,537, pulse height analyzer.
NEW JERSEY:	$47,100
Woodbridge	Pressure Technology Corp. of America, $47,100, high pressure unit for tensile testing, wire drawing and extruding under hydrostatic pressures at ambient temperatures.
NEW YORK:	$32,900
Schenectady	General Electric Co., $32,900, ultra-high vacuum system.
OHIO:	$4,447,883
Cleveland	International Business Machines, $4,343,783, purchase of rented IBM machines.
Fremont	Valley Electric Co., $78,600, installation of safety systems for the Cryogenic propellant pressurization and Dynamics Test Rig at Plum Brook Station.
Willoughby	Watkins & Assoc., $25,500, design of electrical power, control, communication and instrumentation systems for Zero Gravity Research Facility.
PENNSYLVANIA:	$97,327
Ft. Washington	Lawrence Systems Corp., $31,993, high frequency sinusoidal flow control system.
Pittsburgh	Westinghouse Electric Corp., $65,334, research and experimental program to study electric collision cross sections in metal vapors.
WASHINGTON:	$60,000
Richland	U.S. Atomic Energy Commission, $60,000, irradiation of 25 capsules.

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IX Conferences
1965
Engineering
Conference

FOR RELEASE: WEDNESDAY A.M.'S
March 31, 1965

Release 65-19

Henry T. Jacques
(res: 251-1047)

CLEVELAND, Ohio, March 31 -- Today is NASA day at the 1965 Engineering Conference of the American Society of Tool and Manufacturing Engineers, meeting here this week.

Four scientists from the National Aeronautics and Space Administration's Lewis Research Center will address a technical session of the five-day conference this morning.

The afternoon will be devoted to a tour of Lewis, NASA's second largest center, where actual processes, equipment, and facilities will illustrate "Space Age Manufacturing," the day's theme.

Dr. Walter T. Olson, assistant director, will open the technical session by describing the nation's program of space research and development and the role of the Lewis Research Center in carrying out this program. His talk is entitled "Steps Into Space."

Next, George Tulisiak, head of the Welding Section at Lewis, will discuss "Aerospace Fabrication Techniques." Tulisiak is a specialist in metallurgical problems and welding of space propulsion components.

"Advances in Materials for Use at Low and Intermediate Temperatures" will be the topic presented by Richard H. Kemp, head of the Powerplant Structures Section. He specializes in stress and vibration research in propulsion structures.

- more -

Dr. Hubert B. Probst, head of the Refractory Components Section, will review "Advances in Materials for Use at High Temperatures." Dr. Probst's work is in high-temperature, high-strength materials, oxidation at high temperatures, and mechanical deformation of tungsten.

The afternoon tour of Lewis will include stops at the Materials Processing Laboratory, the 10X10 Supersonic Wind Tunnel, Electric Propulsion Laboratory and the Propulsion Systems Laboratory.

The ASTME annual conference is being held at the Cleveland-Sheraton Hotel and includes an exposition at Public Auditorium.

Dr. Abe Silverstein, Lewis director, is among distinguished Clevelanders serving on the honorary sponsoring committee for the conference.

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FOR RELEASE: IMMEDIATE

Release 65-20

Joann T. Temple
(res: 234-6177)

CLEVELAND, Ohio, Mar. 16 -- A low-temperature battery, being developed for future space use, has been successfully tested at 100 degrees below zero, according to engineers at the National Aeronautics and Space Administration's Lewis Research Center here.

When fully developed, the battery could be used on Mars where the nighttime temperatures dip to 100 below zero and the average daytime temperature is 30 below. Batteries for use on the Moon must also be low-temperature devices to withstand the minus 200 degree lunar night.

Present batteries have definite temperature limitations from 0 to 200 degrees. Beyond this range, they do not operate well, if at all.

The new battery, being developed for NASA by the Livingston Electronic Company, Montgomeryville, Pa., delivers constant power over a range from 100 degrees below to 68 degrees above zero. Designed as a primary, non-rechargeable battery, single cells have repeatedly been operated over their full 72-hour-life requirement and at both temperature extremes.

Bernard Lubarsky, Chief, Space Power Systems Division at Lewis, reports that three days at -100^{0} is a record for battery operation.

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FOR RELEASE: IMMEDIATE

Release 65-26

Joann T. Temple
(res: 234-6177)

CLEVELAND, Ohio, March 31 - Experimenters from the National Aeronautics and Space Administration's Lewis Research Center here are planning a sounding rocket experiment for launch tonight from NASA's Wallops Island Station in Virginia.

Andrew E. Potter, Lewis project scientist, explained that the rocket experiment is designed to study the airglow--a glowing layer of the atmosphere seen very clearly edge-on by astronauts but virtually invisible from the ground.

The Lewis experiment, aboard a two-stage Nike-Apache solid rocket, will study the atmosphere for airglow from an altitude of about 30 to 90 miles. A thorough understanding of this atmospheric layer may help to understand radio propagation because signals are frequently bounced off the ionosphere at this level.

The experiment itself is studying three wave lengths of light--one in the red part of the spectrum, another in the yellow, and a third in the green. The altitude of the airglow will be measured with phototubes mounted on the rocket.

Dr. Potter explained that a 26-inch diameter mylar balloon is aboard to help the scientists correlate their measured light intensity and altitude with the density of the atmosphere.

The balloon, coated with aluminum, will be released at the peak of the rocket's trajectory. Radar tracks of the balloon's descent can then be used to calculate the air density.

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I LRC Plum Brook

FOR RELEASE: IMMEDIATE

LRC Release 65-27

Henry T. Jacques
(res: 251-1047)

APR 12

SANDUSKY, Ohio -- A full-term, 10-year operating license has been granted the National Aeronautics and Space Administration's Plum Brook Reactor Facility here by the Atomic Energy Commission.

Receipt of the license was announced today by H. Brock Barkley, Jr., Chief of the Plum Brook Station's Reactor Division.

The nuclear test reactor has been operating under an AEC provisional license up until this time.

The procedure for obtaining a 10-year license required a full review of reactor and experiment operation by AEC's Division of Reactor Licensing and the Commission's Advisory Committee on Reactor Safeguards.

The Plum Brook Reactor, which produces 60,000 kilowatts of thermal power at peak operation, is being used in basic research experiments associated with NASA's plans to develop a nuclear rocket for interplanetary exploration, and the development of systems and compontnts for space nuclear auxiliary power.

The reactor became a working research tool in July 1963 with the completion of the first cycle in which experiments were conducted. Since then, 32 cycles have been completed.

- more -

During 1964 -- the first full year of operation for the experimental program -- a number of significant accomplsihments were recorded, including irradiation of a complete operating thermionic diode; the start of a neutron diffraction experiment; and completion of alumina insulators irradiation, thermal conductivity of refractory fuel compounds experiment, and digital computer radiation resistance techniques study.

Work at the Sandusky station is under the direction of the Lewis Research Center, Cleveland, of which Plum Brook is a part.

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FOR RELEASE: IMMEDIATE

Release 65-33

Hugh W. Harris
(res: 234-2486)

CLEVELAND, Ohio, May 14 -- More than $4.8 million in major contracts were awarded during April by the National Aeronautics and Space Administration's Lewis Research Center here in support of its space research and development programs.

Contracts of $25,000 or more went to companies in 15 states. They are listed alphabetically by state and city.

CALIFORNIA:	$1,675,700
Sacramento	Wismer-Becker, $1,196,000, construction of electrical and instrumentation systems for the Spacecraft Propulsion Research Facility at Plum Brook.
San Diego	General Dynamics Corp., $260,000, experimental and evaluation studies of a co-axial plasma gun accelerator. International-Harvester Co., $119,800, development of protective coatings for tantalum.
Redondo Beach	Thompson Ramo Wooldridge, $99,900, analytical and experimental study of porous metal ionizers.

- more -

COLORADO:	$70,680
Denver	Stearns Roger Corp., $70,680, dismantle, crate and load for shipment equipment located at Offutt, AFMB Sites, Omaha, Nebraska.
FLORIDA:	$1,000,000
St. Petersburg	Honeywell, Inc.,$1,000,000, management and technical capabilities for the Centaur guidance system program.
ILLINOIS:	$29,159
Palatine	Nuclear Data, Inc., $29,159, spectrum stabilizers, buffer tape storage system and tape transport for use with existing pulse height analyzer equipment.
INDIANA:	$299,074
Indianapolis	General Motors Corp., $299,074, advanced multistage axial flow compressor study.
KENTUCKY:	$120,900
Paducah	U.S. Atomic Energy Commission, $120,900, zero gravity capsules.
MICHIGAN:	$74,545
Madison Heights	Bendix Corp., $74,545, investigation of oxidation resistant materials for transportation cooled gas turbine blades.
MISSOURI:	$33,000
St. Louis	Monsanto Co., $33,000, polyphonyl ether lubricant.

- more -

NEW JERSEY:	$154,717
Newark	Weston Instruments, Inc., $26,871, wattmeter and current transformer.
Wayne	American Cyanamid Co., $94,753, high-performance light-weight electrodes for hydrogen-oxygen fuel cells.
West Orange	Vitro Corporation, $33,093, development of non-oxidation resistant nickel base dispersion strengthened alloys.
NEW YORK:	$60,233
Buffalo	Curtiss-Wright Corp., $60,233, development and evaluation of cobalt-base oxidation resistant dispersion strengthened alloys.
OHIO:	$331,376
Cleveland	Radigan & McGilly Moving & Storage, $28,315, moving service. Feldman Brothers, $157,000, installation of accelerator, decelerator and associated piping for the Zero Gravity Research Facility. R. Hanson Co., $43,474, services, labor and material to install a non-destructive test facility in the Technical Services Building.
Columbus	Elsberry Contractors, $70,137, cryogenics propellant pressurization and dynamics testing facility piping systems. Batelle Memorial Institute, $32,450, tungsten shield assembly.
PENNSYLVANIA:	$108,201
Philadelphia	M&T Co., $33,344, maintenance of boiler room at DEB.
Towanda	Sylvania Electric Products, Inc., $74,857, purification of submicron powders.

- more -

TENNESSEE:	$200,000
Oak Ridge	U.S. Atomic Energy Commission, $200,000, heat exchanger test apparatus.
UTAH:	$175,970
Provo	State Inc. of Utah, $175,970, dismantle, crate and load for shipment equipment located at Warren AFMB sites, Cheyenne, Wyoming.
WASHINGTON:	$549,082
Seattle	Boeing Co., $549,082, Lunar Orbiter shroud systems.

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News

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PUBLIC INFORMATION OFFICE
PHONE - (AREA CODE 216) 433-4000 EXT. 415

FOR RELEASE: IMMEDIATE

Release 65-36

Henry T. Jacques
(res: 267-3759)

CLEVELAND, Ohio, May 25 -- Ideas for improvements recently won suggestion awards for seven employees of the National Aeronautics and Space Administration's Lewis Research Center.

Suggestions tnat gained casn awards and commendations for the employees included an adjustable mirror mount for a solar simulator, a new valve for zero-power reactors and several safety improvements.

The ideas will result in tangible and intangible savings to the Government. The cash awards, based on benefits and made under provisions of the Government Incentive Awards Act, ranged from $15 to $35.

Harold W. Christie of the Center's Test Installations Division won a $35 award for his specially-designed, three-way air valve for fuel pumps on two zero-power reactors being used in research work. Use of the valve has more than doubled the life of pump components.

James D. Swiers, Facilities Operations Division, was awarded $35 for his suggestion that solved a problem in an outdoor liquid nitrogen storage sphere. Cold weather was causing the vacuum on the sphere to break, resulting in leaks. He suggested installation of heating cable and insulation to eliminate the problem.

- more -

Richard C. Booth, Instrument and Computing Division, devised an adjustable mirror mount for a solar simulator. The mount, which won Booth a $30 award, has resulted in a decrease in alignment time for a heavy, carbon arc light source. Alignment had been a two-man, two-hour job.

Norman J. Hill, Plant Services Division, came up with a more thorough and rigid shipping procedure for oxygen and acetylene cylinders. The safety merits of his idea won him $20.

Frank A. Cromwell, Plant Services Division, also suggested an improvement for safety and won $15. Cromwell's idea was to place connecting setups for gas cylinders at ground level, thus eliminating the necessity of workers lifting the 170-pound cylinders to an upright position.

Lawrence J. Gotthard, Plant Services Division, had an idea for making fire extinguisher locations more easily visible, even in crowded areas. The idea was to locate extinguisher signs in high places. It won Gotthard $15.

Gordon E. Belmont, Test Installations Division, is $15 richer for suggesting the use of a universal connector in testing liquid hydrogen zero-gravity equipment. The connector reduces the chance of lines to the equipment breaking, when the rig is being shaken for calibration purposes.

Home addresses of the award winners are:

NAME	ADDRESS	CITY
Harold W. Christie	33069 Detroit Road	AVON
James D. Swiers	18890 Fowles Road	CLEVELAND
Richard C. Booth	R. D. # 1 Box 76	DOYLESTOWN
Norman J. Hill	17101 Martha Road	CLEVELAND
Frank J. Cromwell	2311 Grafton Road	GRAFTON
Lawrence J. Gotthard	7031 Filip Boulevard	INDEPENDENCE
Gordon E. Belmont	4636 Martin Drive	NORTH OLMSTED

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PHONE - (AREA CODE 216) 433-4000 EXT. 415

FOR RELEASE: FRIDAY A. M. 'S
MAY 28, 1965
(Released simultaneously in Cleveland and Washington, D. C.)

Release 65-38

Joann T. Temple
(res: 234-6177)

CLEVELAND, Ohio, May 28 -- Scientists at tne National Aeronautics and Space Administration here have successfully operated a high-field strength cryomagnet having a volume many times larger than any previously known.

The cryogenic (extremely low-temperature) magnet will provide research facilities for magnetics, solid state physics and plasma physics, according to Willard D. Coles, Lewis engineer.

The effects of high-strength magnetic fields on life can also be examined in the cryomagnet. Plant life, fruit flies and small animals, placed in the field, may provide information on biological effects and, perhaps, even mutations.

The Lewis cryomagnet creates an intense magnetic field over a volume 4 1/2 inches in diameter. Reseachers have run cautious tests on the new magnet facility by pumping more current into it each day. And, each day, they set a new record in magnetic energy storage---the amount of useful energy that can be stored in and retrieved from the magnet.

- more -

Running the magnet with eight coils and a power input of one million watts, they obtained a magnetic field of 200 kilogauss, at least 20 to 50 times stronger than the magnets used in junk yards to hoist autos about.

This project of creating and studying high-strength magnetic fields powerful enough to exert pressures greater than 25,000 pounds per square inch on materials inside the field, is one vital part of research at Lewis, NASA's main laboratory for research on advanced propulsion and power generation systems.

There is a research need for high-strength fields over a large volume. The Lewis magnet is being developed to meet this need. For example, the resistance and thermal properties of materials vary under the influence of a magnetic field. The cryomagnet provides a facility for studying and documenting these properties.

According to Coles, the Lewis research magnet is the first "really high-field cryogenic magnet." The coils are made of high purity aluminum in a stainless steel channel. They are submerged in liquid neon at 410 degrees below zero. At such extremely low temperatures, the electrical resistance in aluminum is about 500 times less than at room temperatures, thus much stronger magnetic fields can be induced with much less power.

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PHONE - (AREA CODE 216) 433-4000 EXT. 415

FOR RELEASE: SATURDAY P.M'S
MAY 29, 1965

Release 65-39

Joann T. Temple
(res: 234-6177)

CLEVELAND, Ohio, May 29 -- A scientist at the National Aeronautics and Space Administration's Lewis Research Center here has been awarded a patent on a spacecraft system that may have far-reaching effects on the future of interplanetary spaceflight.

Charles A. Low, Jr., explains that development of his radio-isotope generator with its attached propulsion system could expand the possibility of exploration to the more distant planets such as Saturn. If the weight of this new system turns out to be sufficiently low, it could even halve the round-trip time of a Mars mission, now estimated at anywhere from 300 to 700 days. Or, taking the same time as other systems, the radio-isotope unit could carry substantially more payload.

Low stressed that the patent granted to him and William R. Mickelsen, is a patent on the complete system. The radio-isotope generator must be mated directly to an engine or thrustor capable of using the generator's tremendous voltage. This, at present at least, implies that the electrostatic thrustor would have to use particles heavier than the mercury or cesium now used. Low suggests a colloidal particle thrustor.

The radio-isotope generator uses radioactivity to produce electricity directly. It can be called a battery because it works on the same principle. That is, negative charges collect in one place, positive charges in another. Their flow through a circuit is an electric current.

- more -

A radioactive substance emits either negatively or positively charged particles. In the atomic battery, a radioactive substance is coated on a cylinder. If the radio-isotope chosen were Cerium-144, it would emit negative electrons. These electrons would be collected on a second cylinder surrounding the first and a tremendous voltage difference would build up between the two concentric cylinders. This voltage would be at least half a million volts and no existing electric thrustor could use it efficiently.

Thus, the system suggested by Low and Mickelsen would use an as-yet-undeveloped colloidal particle thrustor to round out the power-propulsion system needed for future interplanetary spaceflight.

Although this is a conceptual design, Low explains, "It is a system that will work. Now we have to find out how well it works. At Lewis, research is underway on the possibility of using colloidal particles as the propellant in various thrustor designs and experiments have been done with direct power generation.

"Our patented system is lightweight and has no moving parts. It can go further and carry more payload than any known system."

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FOR RELEASE: IMMEDIATE

Release 65-41

Joann T. Temple
(res: 234-6177)

CLEVELAND, Ohio, June 11 -- How many experiments can a satellite perform? How fast can it transmit information back to Earth from receiving stations? How long can it continue to operate?

All these questions are dependent, at least in part, on the amount and kind of electric power system that the satellite will carry into space with it.

Present satellites and spacecraft carry from 10 to 500 watts of power supplied by solar cells---tiny batteries that convert sunlight into electricity--supplemented by heavy storage batteries. Sometimes this seemingly small amount of power is heavy enough to bump several experiments from a crowded spacecraft.

Conventional solar cells like those used on Telstar and other early satellites are slices of large silicon crystals. These cells are heavy for the power they generate and require rigid panels for support. And a great many cells are needed. For example, Mariner Mars carries 28,224 separate solar cells to provide its 640 watts of maximum power near Earth. These cells are mounted on four paddles, each nearly three feet wide and seven feet long. Their total weight is 74.8 pounds, almost 13 per cent of the total spacecraft weight. How much more might Mariner have been able to do with a lighter power source?

- more -

Thus, a space age dilemma--the more experiments you have, the more power you have, the more power you need and the more power you put on board, the less room you have for experiments.

Scientists at the National Aeronautics and Space Administration's Lewis Research Center here are approaching this dilemma in a number of ways. Accurately evaluating solar cells allows less overlap. An intensive program to calibrate cells should soon reduce the number of margin-of-safety cells necessary on future satellites.

The Lewis calibration program indicated that the solar array planned for Nimbus I, the first earth-oriented weather satellite, would yield six per cent less power than predicted by power system designers. The spacecraft design was modified accordingly and, after its launch on August 28, 1964, Nimbus performance proved the Lewis prediction correct.

Improving the efficiency of cells would reduce the numbers required. Accordingly, minute grid lines were added to the cells. This aids electrical flow sufficiently to get the same output with 20 per cent fewer cells.

Diffusing phosphorous into the top surface and covering the finished cell with a fused quartz glass yields a cell 12 times more radiation resistant. A new slicing method allows cells that are 45 per cent lighter.

Impurities are added to the silicon crystals before they are made into solar cells. Boron is a common additive, but selection of the right impurity can improve the cell. Adding aluminum impurities makes everything better. The efficiency is higher. The cell is at least 10 times more resistant to radiation than even the best commercially available cell.

In the course of developing these aluminum-doped cells, Lewis researchers had to develop a new electrode alloy and devise a new procedure for putting it on the cell.

In previous cells, the electrodes had been a problem. They peeled off the cell and, occasionally, impurities in the electrode would even damage the cell. The new electrode of cerium and silver has proven to be superior to other electrodes in these respects.

Building a lighter, flexible cell that is just as efficient as the crystal cell could be a better solution than uprating the crystal cell. A lighter, more flexible cell exists, but its efficiency is a paltry 4 per cent compared with the 11 per cent mark of the best commercially available cells.

These flexible cells are really thin films of a semiconductor material deposited on a lightweight film substrate. Such thin films have been made by evaporating a photovoltaic semiconductor onto a metal foil in a high vacuum.

This established evaporation process does not work with all semiconductors. For example, the semiconductor gallium arsenide will split into gallium and arsenic when it is vaporized.

Lewis is working with several processes to handle such uncooperative semiconductors. One such process is "sputtering." For example when particles of gallium arsenide are sputtered off an electrode by high voltages instead of being evaporated off with heat, they will deposit intact on the film surface.

Another process is spray deposition where chemicals such as cadmium and sulfur that will react with each other on a hot surface are dissolved in water. When the solution is sprayed on a heated surface, it reacts to form a thin film of cadmium sulfide, a semiconductor.

Ion-plating, a combination of evaporating and sputtering, and flash evaporation---rather like dropping water on a hot stove---are being investigated also. Co-evaporation involves evaporation of the two semiconductor components separately and collecting the mixed vapors on a heated surface.

Research is underway at Lewis on reducing the weight and improving the efficiency of thin film solar cells.

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FOR RELEASE: IMMEDIATE

Release 65-42

Henry T. Jacques
(res: 267-3759)

CLEVELAND, Ohio, June 11 -- Some 45 NASA graduate trainees from universities in this area will be visiting the Lewis Research Center today.

The visitors, whose studies are being supported by NASA, are from Case Institute of Technology, Western Reserve University, Kent State University, and the University of Toledo. They are all graduate fellows in aerospace-related fields at these schools.

Object of the visit is to acquaint the graduate fellows with a working NASA Center. They will hear discussions on air-breathing propulsion and the Supersonic Transport, plasma physics, electric power for space, and materials during their tour of various Lewis facilities.

This support of graduate students is part of NASA's sustaining university program. It is under the general direction of the Office of Grants and Research Contracts, NASA Headquarters.

Dr. Thomas L. K. Smull, Director of the Headquarters office, and Dr. Walter T. Olson, Lewis Assistant Director, will welcome the students to the Center.

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FOR RELEASE: IMMEDIATE

Release 65-46

Joann T. Temple
(res: 234-6177)

CLEVELAND, Ohio, June 25 -- Extensive research on the properties and engineering performance of liquid metals is underway at the National Aeronautics and Space Administration's Lewis Research Center here and scientists recently reported a successful test of a large-scale facility used to investigate the boiling of liquid sodium.

Liquid metals have found exotic uses for the last 36 centuries. Archaeologists tell us that the ancient Egyptians used mercury both for medicinal purposes and to separate gold and silver from their ores. Now mercury and other metals which are liquid within a few hundred degrees of room temperature are being considered for a major role in space exploration.

The liquid alkali metals--sodium, potassium, lithium, cesium--have excellent heat transfer capabilities. This, coupled with their large liquid range, may make them ideal working fluids for the future advanced systems needed to generate megawatts of electric power in space.

James P. Lewis, a NASA engineer, explains that such power generating systems will operate much like the steam-driven powerplants used to produce electricity on earth. Except, instead of water, they will use a liquid metal which allows the system to run much, much hotter than steam temperatures. Sodium, for example, boils at 2000°F. With the higher temperature comes increased efficiency and smaller size, especially for the critical radiator.

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Liquid metals are hard to handle--and pose many as-yet-unanswered questions in liquid metals technology: What materials can the pipes be made out of to withstand the excessive temperatures of boiling metals? Will the fluid metals corrode the pipes? How does a liquid metal boil? How does it flow during boiling or condensing? Will the turbines and pumps be eroded? What, exactly, are each metal's heat transfer capabilities?

Answers to these questions require detailed study under actual operating conditions. Thus, Lewis' research group set about studying boiling sodium.

Exotic research has exotic problems. To withstand 2000° boiling sodium, the research equipment had to be made of columbium---a high-temperature, refractory metal. Columbium, too, has its problems. It cannot be exposed to air at high temperatures because it will absorb oxygen in large quantities, lose its strength, and become brittle. New welding techniques and facilities had to be developed before the boiler and condenser units could be built. These problems were met with clean-room facilities developed by Lewis' Technical Services Division.

The completed boiler and other columbium components must be tested in a special environment to prevent oxygen contamination. A large 17-foot-long by 7-foot-wide vacuum tank provides the necessary environment. The single-entrance to this tank is guarded by a portable clean room---a tent-like structure of vinyl plastic that filters out contaminating particles.

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FOR RELEASE: IMMEDIATE

Release 65-47

Hugh W. Harris
(res: 234-2486)

CLEVELAND, Ohio, June 29 -- More tnan $10.5 million in major contracts were awarded during May by tne National Aeronautics and Space Administration's Lewis Research Center nere in support of its space research and development programs.

Contracts of $25,000 or more went to companies in 15 states. They are listed alphabetically by state and city.

CALIFORNIA:	$1,208,372
Azusa	Aerojet-General, $103,094, cryogenic resins for glass filament-wound composites.
Malibu	Hugnes Aircraft Co., $89,885, low work function cathode development.
Mountain View	Vidar Corp., $124,375, five digital data acquisition system.
Pasadena	Electro-Optical Systems Inc., $28,244, laser system for use in diagnostic studies of plasma. Electro-Optical Systems Inc., $501,844, modification, fabrication, extended testing and evaluation of electron bombardment cesium ion engine systems.
Redondo Beach	Thompson Ramo Wooldridge, $247,930, develop large high perviance ionizers.
San Diego	International Harvester Co., $113,000, protective coatings for chromium based alloys.

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DELAWARE:	$112,082
Wilmington	E. I. Dupont de Nemours & CO., $112,082, fluro-carbon base lubricant for research.
FLORIDA:	$1,714,011
West Palm Beach	United Aircraft Corp., $563,542, development of a short-length turbojet combustor. United Aircraft, $611,100, experimental evaluation of advanced compressor concepts, TASK VII. United Aircraft, $539,369, experimental evaluation of advanced compressor concepts, TASK III.
INDIANA:	$1,996,172
Indianapolis	General Motors Corp., $782,275, experimental evaluation of advanced compressor concepts, TASK IV. General Motors Corp., $406,302, experimental evaluation of advanced compressor concepts, TASK V. General Motors Corp., $807,595, experimental investigation of advanced concepts to increase turbine blade loading.
KENTUCKY:	$309,760
Paducah	U. S. Atomic Energy Commission, $252,960, heat exchangers. Atomic Energy Commission, $56,800, single stage compressor.
MASSACHUSETTS:	$31,715
Waltham	Jarrel-Ash Co., $31,715, plane grating spectograph.
MINNESOTA:	$28,699
Minneapolis	Research Inc., $28,699, temperature and servo controllers.

- more -

NEW JERSEY:	$748,846
Denville	Thiokol Chemical Co., $99,024, jelling of cryogenic oxidizers.
Metuchen	Gulton Industries, Inc., $65,261, investigation of battery active nickel oxidizer.
W. Long Beach	Electronic Assoc., Inc., $54,836, expansion components for two analog computers. Electronic Assoc., Inc., $25,996, test console system. Electronic Assoc., Inc., $33,543, electronic resolver system.
Wood-Ridge	Curtiss-Wright Corp., $470,186, turbine stator combustor integration in air-breathing turbine engines.
NEW YORK:	$57,410
West Nyack	Chromalley Corp., $57,410, protective coatings for chromium-based alloys.
OHIO:	$2,247,137
Cincinnati	General Electric Co., $234,447, investigation of stability of hydrodynamic journal bearings. General Electric Co., $286,911, computer programs to accurately predict cooled turbine blade metal temperatures. General Electric Co., $628,268, experimental evaluation of advanced compressor concepts, TASK VI. General Electric Co., $583,898, experimental evaluation of advanced compressor concepts, TASK I. General Electric Co., $68,807, dispersion-strengthened chromium alloys.
Cleveland	Thompson Ramo Wooldridge, $115,552, high temperature cobalt-base alloys by conventional alloying techniques for application as jet engine stator vanes. General Electric Co., $58,000, chromium alloys in strip and plate form.

Cleveland (Cont'd.)	Lake Erie Electric., $32,370, installation of 15,000 horsepower motor control interconnect and instrumentation interconnect system for Engine Research Building. V & V Co., $124,166, steam accumulator systems. Suburban Piping, $58,200, fabricating and installing large-sized air piping in Engine Research Building.
Columbus	Elsberry Contractors, Inc., $30,038, fabrication and installation of helium storage structure and manifold.
Westlake	L. C. Smith Co., $26,480, ball bearing screw actuator.
PENNSYLVANIA:	$1,828,516
Pniladelpnia	General Electric Co., $49,899, tnermal integration study of space power, life support and space station subsystems. Araco Co., Inc., $1,649,000, mechanical process and utility systems for tne Spacecraft Propulsion Research Facility at Plum Brook.
Pittsburgn	Westinghouse Electric Corp., $72,000, development of tne basic tecnniques for welding and evaluating refractory/austenitic bimetal tubing.
Towanda	Sylvania Electric Products, Inc., $57,617, development of nonoxidation resistant cobalt-base dispersion-strengtnened alloys.

TENNESEE:	$300,000
Oak Ridge	U.S. Atomic Energy Commission, $200,000, determination of the amount of hydrogen and oxygen generated by decomposition of aqueous solutions exposed to reactor radiation. U.S. Atomic Energy Commission, $100,000, production of tungsten enriched in W183 isotope.
VIRGINIA:	$65,432
Falls Church	Melpar, Inc., $65,432, development of dispersion strengtnened nickel base corrosion resistant alloys.
WASHINGTON:	$51,000
Richmond	U.S. Atomic Energy Commission, $51,000, W-$UO_2$ fuel capsule irradiation services.

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FOR RELEASE: 2 p.m., EDT
July 29, 1965
(Also released in Washington, D.C.)

Release 65-51

(Hugh W. Harris)

CLEVELAND, Ohio, July 29 --Greatly increased life for ball and roller bearings used in everything from machinery to satellites is expected based on the results of an extensive research program announced today by the National Aeronautics and Space Administration's Lewis Research Center.

This advance in rolling element bearing technology is expected to result in savings of millions of dollars a year in replacement bearings and many more millions in extended life of machines.

Four to five times greater fatigue life can be realized from bearings made according to the Lewis hardness differential guide than from bearings which do not follow this guide.

The Lewis team that made this latest advance includes Erwin V. Zaretsky, Richard J. Parker and William J. Anderson. They conducted

- more -

a program to extend the fatigue life of rolling contact bearings.

Lewis engineers have been working toward increasing the life and reliability of bearings for many years. During World War II bearing research centered on reciprocating engines used in fighters and bombers, both in the structure of the bearings and lubrication. Next came work on bearings for jet and rocket engines.

A number of advances in bearing technology have been made by Lewis engineers during this time. This includes the discovery that the surface of balls made from drawn metal rods do not have uniform fatigue strength because of the fiber orientation. It was also proven that the smallest balls possible should be used in bearings for rocket engines.

Fatigue is one of the factors that limits the useful life of a bearing. It appears as the loss of material from the balls or races, giving them a pitted appearance. This is caused by repeated flexing of the surfaces as they come in contact with each other. As soon as pitting appears, the bearing is no longer useful.

Zaretsky's group had three objectives: (1) to determine if a maximum bearing fatigue life does exist at some optimum component hardness combination, (2) to determine if a relation exists between plastic deformation, relative hardness of bearing components and fatigue life, and (3) to

determine if residual stresses correlate with component hardness combinations and fatigue life.

Their tests showed that bearing load capacity and fatigue life are greatest where the rolling elements of the bearing are between one and two points harder (measured on the Rockwell C scale) than the races.

Full scale bearing tests demonstrated that by assembling bearings according to this hardness differential guide, four to five times greater fatigue life could be achieved than with bearings manufactured by normal methods. At present, manufacturers attempt to assemble bearings with balls and races of the same hardness.

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BIOGRAPHICAL MATERIAL

WILLIAM J. ANDERSON, Chief, Bearings Branch, joined NASA's Lewis Research Center in September 1950 as a research engineer. A native of Brooklyn, New York, Anderson attended Massachusetts Institute of Technology where he received a B. S. degree in mechanical engineering in 1950. In 1957, Case Institute of Technology awarded him an M. S. degree in aeronautical engineering. He has specialized in bearing and lubrication problems in spacecraft and aircraft propulsion and auxiliary power systems. He has written more than 30 papers in this field and recently co-authored a book on "Advanced Bearing Technology." In 1962, Anderson received the Hunt Award for the best American Society of Lubricating Engineers paper of the year. He has lectured at the University of California and Case Institute on advanced bearing problems. Anderson and his family reside at 5031 Devon Drive, North Olmsted, Ohio.

RICHARD J. PARKER joined NASA's Lewis Research Center in 1956. In June 1965 he was awarded a bachelor of electrical engineering degree from Fenn College in Cleveland, receiving the President's Medallion as the "Outstanding Senior" of his graduating class. A native of Lodi, Ohio, Parker's initial work with NASA was with the aircraft crash fire prevention program. He later was assigned to the Fatigue Section of the Bearings Branch and is presently working on high-temperature bearing materials, rolling contact fatigue and magnetic bearing research. He has authored 12 research reports and technical papers. Parker and his family reside at 3 Cadet Drive, North Ridgeville, Ohio.

ERWIN V. ZARETSKY, Section Head, Bearings Branch, joined NASA's Lewis Research Center in July 1957 as an aerospace research engineer. A native of Chicago, he was graduated from Illinois Institute of Technology in 1957 with a B. S. degree in mechanical engineering. In 1963, Zaretsky received his Juris Doctor from the Cleveland-Marshall Law School of Baldwin-Wallace College. In his work at Lewis, Zaretsky conducts and supervises analytical and experimental research on rolling contact phenomena involving materials and lubricants. This research is aimed at advancements in stress analysis and gaining knowledge of rolling contact phenomena involving materials and lubricants for high-energy rocket turbopumps and for closed cycle space power systems. Zaretsky and his family reside at 3660 Warrensville Center Road, Shaker Heights, Ohio.

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FOR RELEASE: IMMEDIATE

Release 65-57

Joann T. Temple
(res: 234-6177)

CLEVELAND, Ohio, Aug. 24 -- Space power scientists at the National Aeronautics and Space Administration's Lewis Research Center here are studying "pounding radiators" in a unique facility.

Potassium vapor at some 1400° F. rushes into the header of their space radiator at about 80 mph and vapor speeds can peak above 300 mph at the inlets to the nine radiator tubes. As the hot vapor moves down the tubes, it radiates heat and begins to condense. The liquid potassium formed from vapor is some 800 times more dense or smaller than the vapor from which it condensed and it moves that much slower.

Herein could be a problem. Does a mixture of liquid and vapor at the condensing point create a roadblock? How rapidly does this condensing process take place? Is there a smooth transition from vapor to liquid in the radiator? What is the temperature of the outer surface of the tubes?

- more -

Are there any flow distribution problems? Do all the tubes behave the same way? If one is plugged what happens to the others? Are there any major problems in radiator design?

These are all questions that must be answered before NASA begins to build the next generation of powerplants for space--powerplants capable of producing megawatts of electric power. Although these are not needed now, present estimates for spaceflight beyond the moon require power systems that can run hot enough to produce electricity efficiently with a lightweight reactor-turbine-radiator-condenser system similar to the steam driven powerplants now used on earth.

Such a system for space would have to use a fluid other than water. The excellent heat transfer properties and wide liquid range of alkali metals such as potassium make them attractive for this future application, but much fundamental work on these metals that are liquid within a few hundred degrees of room temperature remains to be done.

The radiator study at Lewis is part of this work. As Loren W. Acker and David B. Fenn, project engineers, explain, the nine-tube radiator is part of a power generation system, complete except for a turbine. Each tube is 14 feet long and made of very thick stainless steel.

The radiator is run in an 18 foot long, 8 foot wide vacuum tank at Lewis. Since it was designed as a space radiator, the thick tube walls offset the likelihood of micrometeoroid damage. The fins attached to the tubes increase the radiation area and this direct condensing radiator is providing much basic information for future space missions.

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FOR RELEASE: IMMEDIATE

Release 65-60

Ed Chambliss
(res: 221-3247)

CLEVELAND, Ohio, Aug. 31 -- A Centaur rocket and a model of Mariner IV highlight the National Aeronautics and Space Administration's display at Cleveland's Natural Science Museum.

The NASA display, covering some 785 square feet, is being coordinated by the Lewis Research Center to demonstrate some of Lewis' recent contributions to the space program.

The Centaur rocket is similar to the vehicle launched successfully into a simulated lunar-transfer trajectory August 11 at Cape Kennedy. The upper stage vehicle develops 30,000 pounds of thrust by burning liquid hydrogen and liquid oxygen in space. Eventually, the Centaur will soft-land a Surveyor spacecraft on the moon for surface studies in support of future manned Apollo missions. The full-scale Lewis vehicle is located just outside the museum entrance.

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The Mariner IV exhibit depicts the spacecraft which traveled 325 million miles through space to transmit pictures of Mars to Earth on July 14. These photographs show totally unexpected features of the Red Planet and contradict many ground-based observations made with telescopes.

Lewis engineers managed the Atlas-Agena D booster for Mariner IV. The center also defined the launch vehicle requirements and followed through on the design, fabrication, test, launch preparations of the spacecraft and launch up to spacecraft separation. The Mariner IV model is mounted inside the museum near display panels which show pictures of the crater-pocked Martian surface.

Other NASA exhibits can be seen at the museum's Ralph Miller Planetarium, including ion propulsion engine prototypes and models of the moon's surface. NASA has been contributing displays to the museum for about ten years.

The Centaur will be removed from the museum September 1, but Mariner IV will remain there until October 1.

Admission to the museum, which is best known for its collection of fossil fish, is free on Mondays and Tuesdays. On other days the admission charge is $.25 for children and $.50 for adults. The museum is open from 9 a.m. until 5 p.m. on weekdays and Saturdays. On Sundays it is open only from 1 - 5:30 p.m.

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News
NASA LEWIS RESEARCH CENTER

21000 BROOKPARK ROAD CLEVELAND, OHIO 44135
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FOR RELEASE: IMMEDIATE

Release 65-67

Hugh W. Harris

CLEVELAND, Ohio, Oct. 1 -- More than $1.9 million in major contracts were awarded during August by the National Aeronautics and Space Administration's Lewis Research Center here in support of its space research and development programs.

Contracts of $25,000 or more went to companies in seven states. They are listed alphabetically by state and city.

CALIFORNIA:	$153,611
Antioch	Fulton Shipyard, $153,611, two pendant controlled overhead traveling cranes.
COLORADO:	$35,041
Denver	Cryogenic Engineer, $35,041, services and material for 1850 gallon dewar.
CONNECTICUT:	$125,600
East Hartford	United Aircraft Corp., $125,600, conversion of two J57 engines for natural gas operation.

- more -

FLORIDA:	$875,350
Cape Kennedy	General Dynamics Corp., $875,350, launch services for Eastern Test Range.
MICHIGAN:	$26,025
Warren	Federal-Mogul-Bower Bearing, Inc., $26,025, powdered alloys and stress rupture specimens.
NEW YORK:	$61,700
New York	Ideal Restaurant Supply $61,700, service, labor and material to install cafeteria facilities for the Engineering Building at Plum Brook.
OHIO:	$536,005
Cleveland	Suburban Power Piping Corp., $25,980, installation and testing of a piping system and Argon gas line for the compressor turbine, Brayton cycle in Engine Research Building. Doan Electric Co., $240,000, construction of electrical, instrumentation and control systems for the Zero Gravity Facility. Lake Erie Electric, $73,900, construction of underground ducts and installation of instrumentation cable. Bristol Co., $27,950, potentiometers.
Dover	General Electric Co., $30,000, support tubes, fuel plate assemblies and material test samples.
North Royalton	Central Contractors & Builders, $83,900, construction of an addition to the Electric Propulsion Research Building.
Willowick	Cleveland Tool & Die Co., $54,275, tooling and coolant channels.

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FOR RELEASE: IMMEDIATE

Release 65-89

Hugh W. Harris

CLEVELAND, Ohio, Dec. 23 -- More than $1.4 million in major contracts were awarded during November by the National Aeronautics and Space Administration's Lewis Research Center here in support of its space research and development programs.

Contracts of $25,000 or more went to companies in nine states and Canada. They are listed alphabetically by state and city.

CANADA:	$99,510
Ottawa	Canadian Commercial, $99,510, meteoroid impact bumper interactions.
CALIFORNIA:	$87,631
Los Angeles	USAF Systems Command, $30,000, Nimbus B SNAP mission hazard analysis.
Santa Ana	Giannini Scientific, $57,631, services and operation of hydrogen plasma generator.
COLORADO:	$126,016
Boulder	U.S. Department of Commerce, $40,000, research and development program on "Superconducting Thin Films."
Denver	Dow Chemical Co., $86,016, polls and machine magnesium plates.

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KENTUCKY:	$110,500
Paducah	U. S. Atomic Energy Commission, $110,500, amplifier test console and advanced combustor assembly.
MASSACHUSETTS:	$44,900
Cambridge	Arthur D. Little, $44,900, modification of a liquifier for use as a helium recondenser.
NEW YORK:	$152,672
Olean	Dresser Industries, $114,935, natural gas compressor system.
Yonkers	Sherkade Construction, $37,737, construction of underground ducts and installation of cable.
OHIO:	$469,968
Cleveland	Clevite Corp., $176,955, study of thin film large area of photovoltaic solar energy converters. Suburban Power Piping Corp., $26,600, extension of cooling air system in Engine Research Building. H. K. Ferguson Co., $48,206, design specifications for propulsion components evaluation facility. Midwest Machine & Tool Co., $39,160, hot cave handling equipment.
Huron	Wilkes and Co., $61,957, installation of stainless steel pumpout and recirculation system.
Lima	Westinghouse Electric Co., $81,940, ion engine power conditioners.
North Royalton	Central Contractors & Builders, Inc., $35,150, modifying Annex and Cell No. 1 in Electric Propulsion Research Building.

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TENNESSEE:	$177,430
Oak Ridge	U. S. Atomic Energy Commission, $177,430, advanced ionizer fabrication and testing and enriched uranium burnup and losses.
VIRGINIA:	$49,942
Waynesboro	General Electric Co., $49,942, ion engine power conditioners.
WASHINGTON:	$160,342
Seattle	Boeing Co., $160,342, study of weldments and pressure vessels made of NY150 steel plate.

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